MISTRAL AMERICA

40 - 45 - 50

TRAINING MANUAL

P/N 3676163M1 - EDITION 07-2004

landini

INTRODUCTION

This manual refers to tractor **MISTRAL AMERICA 40 - 45 - 50** manufactured by **LANDINI S.p.A.**. It is divided into sections identified by numbers with three/four figures. The pages of each section are numbered separately.

- The subjects described are listed in the general index and appear in more detail in the specific index of the section in question.
- The date of the relative edition/update is printed at the bottom of each page.
- Pages where future updates are made will have the same print number but the new date of issue.
  These pages will be supplied by a reprint of the duly updated index.
- The information in this manual was up to date on the date printed on the page. Since **LANDINI** constantly updates its range of products, some of the information could no longer be up to date following modifications made for technical or commercial reasons, or to adapt the machines to the laws in force in the various countries of use.
  Consult our Dealers and Assistance Centres if discrepancies are found.

LIABILITY

LANDINI S.p.A. declines all liability for incorrect servicing operations, use of spurious spare parts and tampering with parts of the product.

The person in charge of the personnel is responsible for ensuring that the safety regulations described in the manual are applied. This person must be qualified to carry out the operations required, be familiar and strictly comply with the prescriptions in this manual and the general safety regulations applicable. Failure to comply with the safety regulations may lead to persons being injured and damage to machine components.

PURPOSE OF THE MANUAL

This manual is mainly dedicated to workshop staff.

This manual contains all the necessary technical information concerning the machine, allowing the servicing technicians to work in safety and guarantee that the product remains perfectly efficient throughout its working life. However, it is not a substitute for thorough professional training.

To correctly carry out the servicing activities, it is assumed that the place of work conforms to the current standards governing safety and hygiene.

This manual contains all the information required to correctly carry out modifications, tune ups, repairs and overhauls.

Read this manual carefully before proceeding with any work. Correct repairs are guaranteed and the operators safeguarded from accidents by compliance with the instructions supplied and by using the right tools.

COPYRIGHT

The illustrations and descriptions in this publication are purely indicative.

The Manufacturer reserves the right to make any modifications to the machines considered necessary at any moment for improvement purposes or for manufacturing and marketing requirements, without being obliged to give prior notice.

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GENERAL INFORMATION

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SAFETY NOTES

Personal risk

This warning symbol draws your attention to messages that are important for your safety.
Read the safety notes carefully and comply with the recommended precautions to avoid potential dangers and safeguard your health and personal safety.
This symbol appears in the text along with the following key words:

WARNING - To warn of unsuitable repair operations with potential consequences that could affect the repair technician's safety.

DANGER - To indicate warnings that specifically denote potential dangers for the operator's safety or for other directly or indirectly involved persons.

1

Avoid accidents

The majority of accidents that occur in workshops are caused by failure to comply with some simple and fundamental rule of caution and safety. This is why ACCIDENTS CAN BE AVOIDED IN MOST CASES: all that's needed is to foresee the possible causes and consequently act with due care and caution.

However well a machine is designed and built, it is never possible to absolutely exclude all hazardous situations.

A careful and prudent mechanic is the best guarantee against accidents.

Strict compliance with even only one elementary safety rule would be sufficient to avoid many serious accidents.

DANGER. Never carry out any cleaning, lubricating or servicing operations whilst the engine is running.

General rules

- Carefully comply with the prescribed maintenance and repair procedures.
- Never wear rings, wrist watches, jewellery, loose or flapping garments such as, for example: ties, torn clothing, scarves, unbuttoned jackets or with open zip-fasteners that could become caught in moving parts. You are advised to wear approved safety garments, such as: non-slip footwear, gloves, safety goggles, helmets, etc.
- Never carry out repair work on the machine whilst someone is sitting in the driver's seat, unless this person is an authorized operator who is helping with the operations in progress.
- Only operate the machine and use the relative implements when you are sitting in the driver's seat.
- Do not carry out any work on the machine when the engine is running, unless this is specifically prescribed.
- Stop the engine and make sure that the pressure has been relieved from the hydraulic circuits before removing any caps, covers, valves, etc.
- All servicing work must be carried out with the utmost care and attention.
- Ladders and platforms used in workshops or in the field must comply with the current safety regulations.
- Disconnect the batteries and label all the controls to warn others that work is being carried out. Block the machine and all implements that must be raised.
- Do not check or fill fuel tanks, batteries, or use ignition fluid when smoking or near naked flames as these liquids are inflammable.
- The brakes are disengaged when released by hand for servicing work: in these cases, the machine must be kept under control by means of chocks or similar.

- The fuel pump nozzle must always remain in contact with the filler: Keep it there until you finish filling so as to prevent sparks from being created through an accumulation of static electricity.
- Only use the prescribed hitching points when towing. Make the connections with care: make sure that the provided pins and/or latches are firmly fixed in place before beginning to tow. Keep well away from tow bars, ropes or chains that are pulling a load.
- If possible, use a trailer or truck with a lowered loading platform when transferring a faulty machine.
- When a machine must be loaded on to or unloaded from the transport vehicle, choose flat ground able to provide a solid bearing surface for the wheels of the trailer or truck. Fasten the machine to the truck or trailer platform firmly and block the wheels as required by the haulage contractor.
- Only use auxiliary power sources with grounding circuits able to prevent electric shocks for electric heaters, battery chargers and similar equipment.
- Use hoists and similar equipment with an adequate carrying capacity if heavy parts must be lifted or transported.
- Pay particular attension to bystanders.
- Never pour petrol or diesel fuel into wide and shallow open vessels.
- Never use petrol, diesel fuel or other inflammable fluids as detergents: use the nonflammable and non-toxic solvents available in the shops.
- Protect your eyes by wearing goggles with side guards when using compressed air to clean parts.
- Limit the pressure to 2.1 bar at most, in compliance with the local or national laws in force.
- Do not run the engine in a closed room without adequate ventilation.
- Do not smoke, use naked flames or create sparks in the vicinity when refuelling or handling easily inflammable materials.
- Do not use flames as a means of lighting when repairing the machine or searching for “leaks”.
- Move with the greatest care when working under, on or near the machine. Wear the recommended safety garments: a helmet, goggles and special safety footwear.
- When the engine must be running in order to make the inspections, ask for help from an operator who must remain in the driver’s seat and keep the mechanic under visual control at all times.
- If servicing is required away from the workshop, park the machine on flat ground and block it. If work on slopes is unavoidable, block the machine and move it to a horizontal surface as soon as this can be done within a certain safety margin.
- Do not use crushed or bent chains or ropes: when lifting or towing are required. Always wear suitably thick gloves to handle them.
- Chains must be firmly fixed in place: make sure that the fastening is sufficiently strong to bear the load in question. Have all bystanders move well clear of the connection, chains or ropes used for lifting or towing.
- The area where the servicing operations are carried out must always be kept CLEAN and DRY. Puddles or water or oil stains must be cleaned up immediately.
- Do not form heaps of rags soaked in grease or oil: they could catch fire very easily. Always put them in a closed metal container.
  Check, regulate and lock the driver’s seat before starting the machine or implements. Make sure that there are no bystanders within the range of action of the machine or implements.
- Do not carry objects in your pockets that could drop unseen into the internal mechanisms of the machine.
- Wear goggles with side guards, helmets, special safety footwear and gloves when you could be struck by metal objects and similar, thrown up during the servicing work.
- Use the necessary safety protections when welding operations are carried out: dark glasses, helmets, dungarees, special gloves and footwear. Dark glasses should also be worn by the people not actually doing the work but who are in the vicinity when welding is being carried out. NEVER LOOK AT THE WELDING ARC WITHOUT ADEQUATE EYE PROTECTION.
- Metal ropes become frayed with wear: always protect yourself in an adequate way when handling them (wear gloves, goggles, etc.).

- Handle all parts with the utmost care. Keep your hands and fingers well away from gaps, wheelwork and similar. Always use approved personal protection devices such as safety goggles, gloves and safety footwear.

☞ **Before you get on to the tractor, it is essential for you to have read and strictly complied with the instructions in the operation and maintenance manual.**

Starting

- Do not allow the engine to run in a closed room without adequate ventilation systems able to dispose of the exhaust gas.
- Never put your head, body, limbs, feet, hands or fingers near spinning fans or belts.

Engine

- Before removing the radiator plug completely, turn it very slowly to relieve the pressure in the circuit. Coolant fluid must only be topped up with the engine at a standstill or idling, if hot.
- Do not refuel whilst the engine is running, particularly if it is hot. This could lead to the risk of a fire outbreak if fuel were to be spilt.
- Do not attempt to check or adjust the tension of the fan belts with the engine running.
  Do not regulate the fuel injection pump whilst the machine is on the move.
- Never lubricate the machine when the engine is running.

Electrical systems

- If auxiliary batteries must be used, remember that the cables must be connected in the prescribed way at both ends: (+) with (+) and (-) with (-). Do not short-circuit the terminals. THE GAS ISSUED BY BATTERIES IS HIGHLY INFLAMMABLE. Always leave the battery housing uncovered when recharging, to ensure a more efficient ventilation. Never ever check the battery charge using the "jumpers" obtained by placing metal objects on the terminals. Prevent sparks or flames in the battery area. Do not smoke as this could cause explosions.
- Before proceeding with any work, make sure that there are no fuel or electricity leaks: repair these leaks before proceeding.
- Do not recharge batteries in closed places: make sure that there is adequate ventilation to prevent accidental explosions from occurring due to an accumulation of the gas issued when recharging.
- Always disconnect the batteries before working on the electrical system.

Hydraulic circuits

- Fluid leaking from a very small hole can be almost invisible yet have sufficient force to penetrate under the skin. Use a piece of cardboard or wood if you must check for such leaks. NEVER CHECK FOR LEAKS WITH THE HANDS: immediately seek medical help if fluid penetrates under the skin. Serious infections or dermatitis may occur if you fail to receive prompt medical treatment.
- Use the right tools to check the pressure in the circuits.

Wheels and tyres

- Make sure that the tyres are correctly inflated to the pressure indicated by the manufacturer. Periodically check the rims and tyres to make sure that they are not damaged.
- Keep to the side of the tyre when correcting the inflation pressure.
- Only check the pressure with the machine unloaded and the tyres cold, to prevent incorrect measurements and overpressures. Do not reuse repaired wheel parts as badly made welds, brazing or heating could have weakened them and cause breakage.
- Never cut or weld a rim with a tyre mounted and inflated.
- Block the machine at the front and rear on all wheels before demounting these latter. After you have jacked up the machine, prevent it from dropping by placing supports underneath, in compliance with the current laws in force.
- Deflate the tyres before removing any objects jammed between the treads.
- Never inflate the tyres with inflammable gas. This could lead to explosions and injure bystanders.

Splitting and remounting parts

- Lift and handle all heavy parts with lifting equipment of an adequate capacity. Make sure that the parts are supported by appropriate harness and hooks. Use the lifting eyelets provided. Take care of bystanders near the load being lifted.
- Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.
- Do not twist metal ropes or chains. Always wear safety gloves when handling cables or chains.

GENERAL INSTRUCTIONS

IMPORTANT WARNING

All the maintenance operations and repairs described in this manual must be carried out by the LANDINI assistance network only, in strict compliance with the indications given and using special tools if necessary.
Anyone who carries out the described operations without strictly complying with the instructions becomes personally responsible for any consequent damage.

Battery

Before proceeding with any work, disconnect and insulate the negative battery cable unless other instructions are given for the specific operation required (for example: an operation where the engine must be running). After the operation has been terminated, detach this cable in order to finish the work.

Adjuster shims

Whenever adjustments are made, select the adjuster shims by measuring them one by one with a micrometre and then adding the values gauged: do not trust in the erroneous measurement of the complete pack or in the nominal value given for each ring.

Spinning shaft seals

Comply with the following instructions to correct mount the spinning shaft seals:

- before they are mounted, allow the seals to soak for at least half an hour in a bath of the same type of oil as the one they will be sealing;
- thoroughly clean the shaft and make sure that its operating surfaces are not damaged;
- position the sealing lip towards the fluid. If the lip is the hydrodynamic type, the direction in which the scoring points (considering the direction in which the shaft spins) must tend to make the fluid flow towards the internal part of the seal;
- spread a film of lubricant (oil is preferable to grease) on the sealing lip and fill the gap between the sealing lip and dust guard lip of double-lipped seals with grease;
- fit the seal into its housing by pressing or use a punch with a flat contact surface. Never hit the seal with a hammer or mallet;
- when a seal is mounted, make sure that it is inserted perpendicular to its seat. After mounting, make sure that it touches the supporting ridge (if applicable);
- to prevent the seal lip from being damaged by the shaft, fit an adequate guard whilst the two parts are being assembled.

“O-ring” seals

Lubrificate the O-RING seals before they are fitted into their seats to prevent them from rolling around themselves and becoming twisted as they are mounted, something that would compromise their sealing ability.

Bearings

It is advisable to proceed in the following way when mounting bearings:

- heat them to 80 - 90 °C before fitting them on to their respective shafts;
- cool them before externally fitting them into their seats.

Spring pins

When mounting split tube spring pins, make sure that their notches point in the direction of the force exercised on the pin itself.
Spiral spring pins do not need to be set in any direction when mounted

Notes about spare parts

Only use genuine LANDINI spare parts as only these are able to guarantee the same quality, life and safety as the original components mounted on your machine.
Only **genuine LANDINI spare parts** can provide this guarantee.
Give the following information when ordering spare parts:

- tractor model (commercial denomination) and chassis number;
- engine type and number;
- order number of the required part, which can be found in the "Spare Parts Catalogue", according to which the orders are fulfilled.

Specific equipment

The equipment that LANDINI proses and illustrates in this manual is:

- explicitly researched and designed for work on LANDINI tractors;
- necessary for reliable repairs;
- carefully made and thoroughly tested to provide efficient and long-lasting tools.

Repairers should also remember that using the right equipment means:

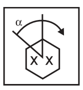
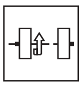
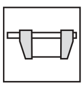
- working in technically optimum conditions;
- obtaining the best result;
- saving time and effort;
- working in greater safety.

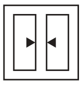
SYMBOLS

Meaning and use

Certain symbols are used in this manual to underline and draw the reader's attention to certain particular aspects of the description, or to indicate the type of operation being illustrated.

The meanings of the various symbols used are described in the table below.

SYMBOLS	MEANING	NOTES
	Warning: personal risk	Indicates a danger with the risk of even mortal accident for the user. Pay the utmost attention to the texts indicated with this symbol.
	Warning: environmental hazard	Indicates a danger with the risk of damage to the natural environment. Pay the utmost attention to the texts indicated with this symbol.
	Caution	Warns that the machine or some other personal property of the user could be damaged.
	Note	Indicates a warning, a note about key functions or some other useful information.
	Prevent damage to material	This indication means that there is a considerable risk of damage to a part, e.g. when the wrong tool is used or an assembly made by means of an incorrect procedure.
	Special tool/ specific equipment	A special tool or specific equipment must be used for the operations.
	Visual observation	A visual inspection must be made. The user must read a measurement value, check an indication, etc...
	Listen	The operator must listen to a noise made when the machine operates. The inspection serves to identify abnormal noise.
	Tighten and torque	Symbol associated with a value: use a torque wrench to suit the value given.
	Torquing with angle	Symbol associated with two values: use a torque wrench to suit the value given and measure the dwell angle at that torque value.
	Adjustment/Regulation	Operation carried out in order to obtain precise values (pressure, preload, relative distance, etc.).
	Measuring/Gauging	Operation carried out in order to measure a value required to restore optimum functional conditions in the correct way.

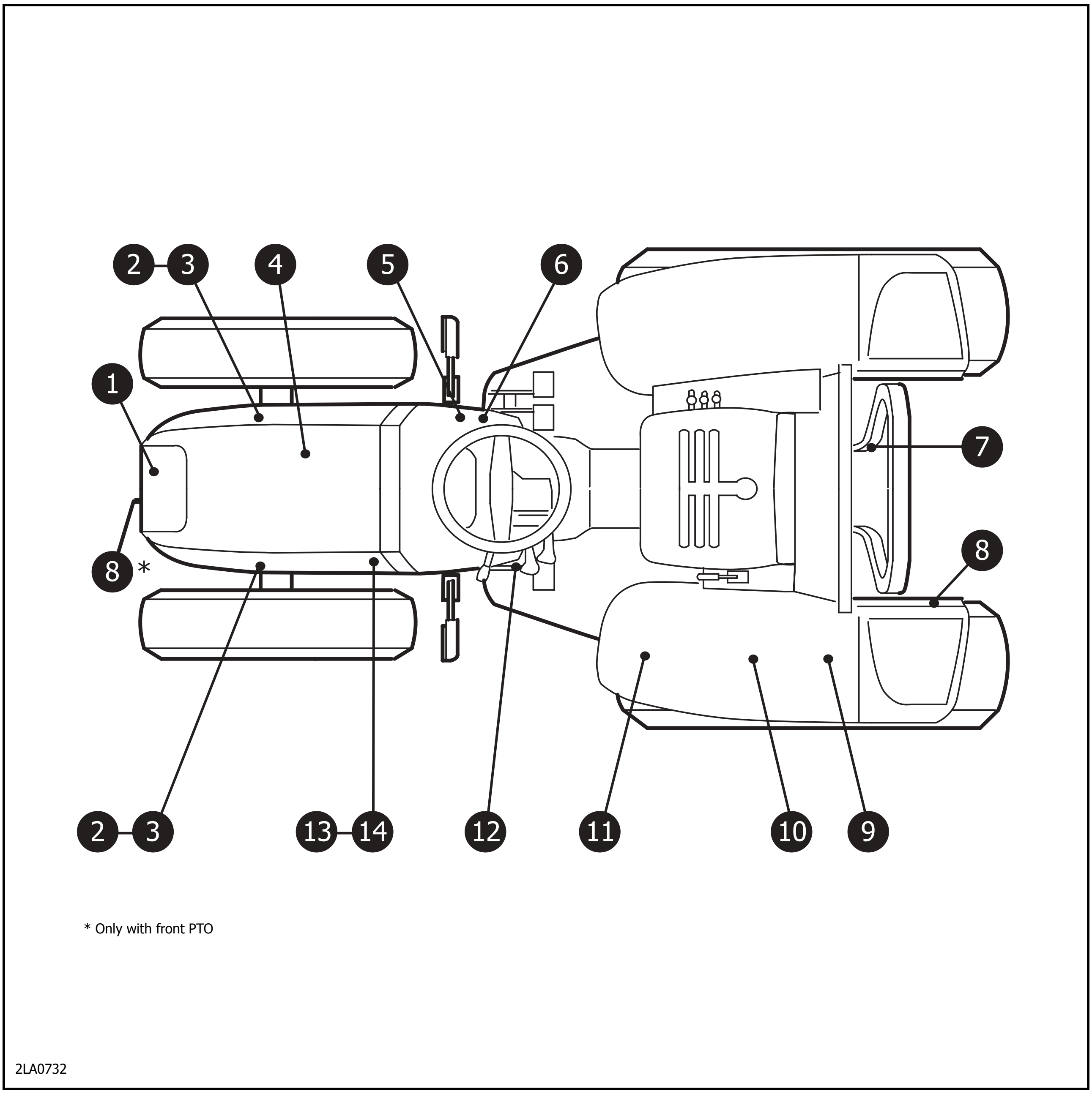
SYMBOLS	MEANING	NOTES
	Lubrication	Lubrication (oiling, greasing, etc...) of a part/ device.
	Sealing/Glueing	Sealant required in order to couple two parts together.
	Positioning	Coupling with relative position references.
	LANDINI Spares.	Indicates that only LANDINI spare parts must be used.

DANGER SIGNS

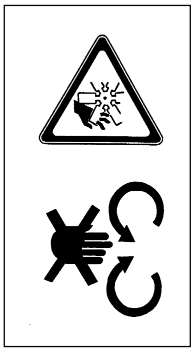
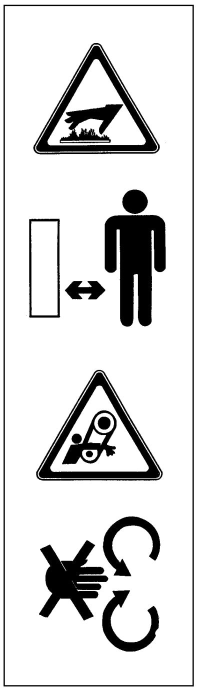
If a tractor part bearing a decal with a safety note (yellow colour) is replaced, it is ESSENTIAL to affix the same decal to the spare part.

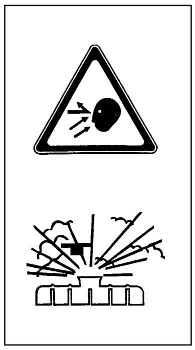
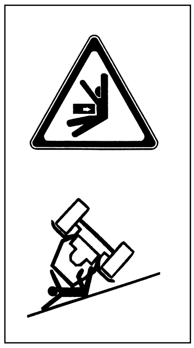
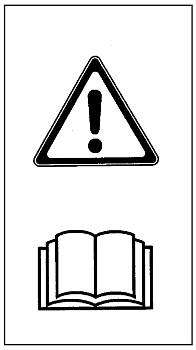
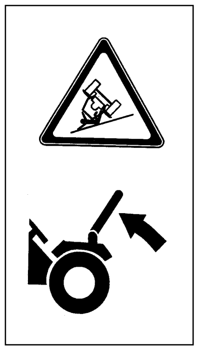
A complete list of all the places where decals are applied is given below.

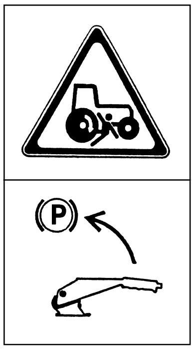
Positions of the danger decals – WEO markets

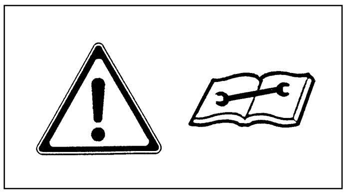
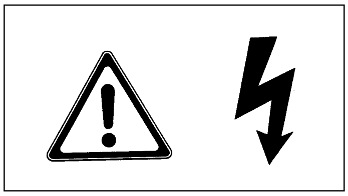
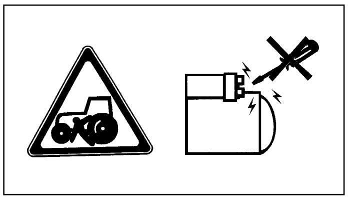


Positions of the danger decals
Complete set of danger decals WEO 4203959M91

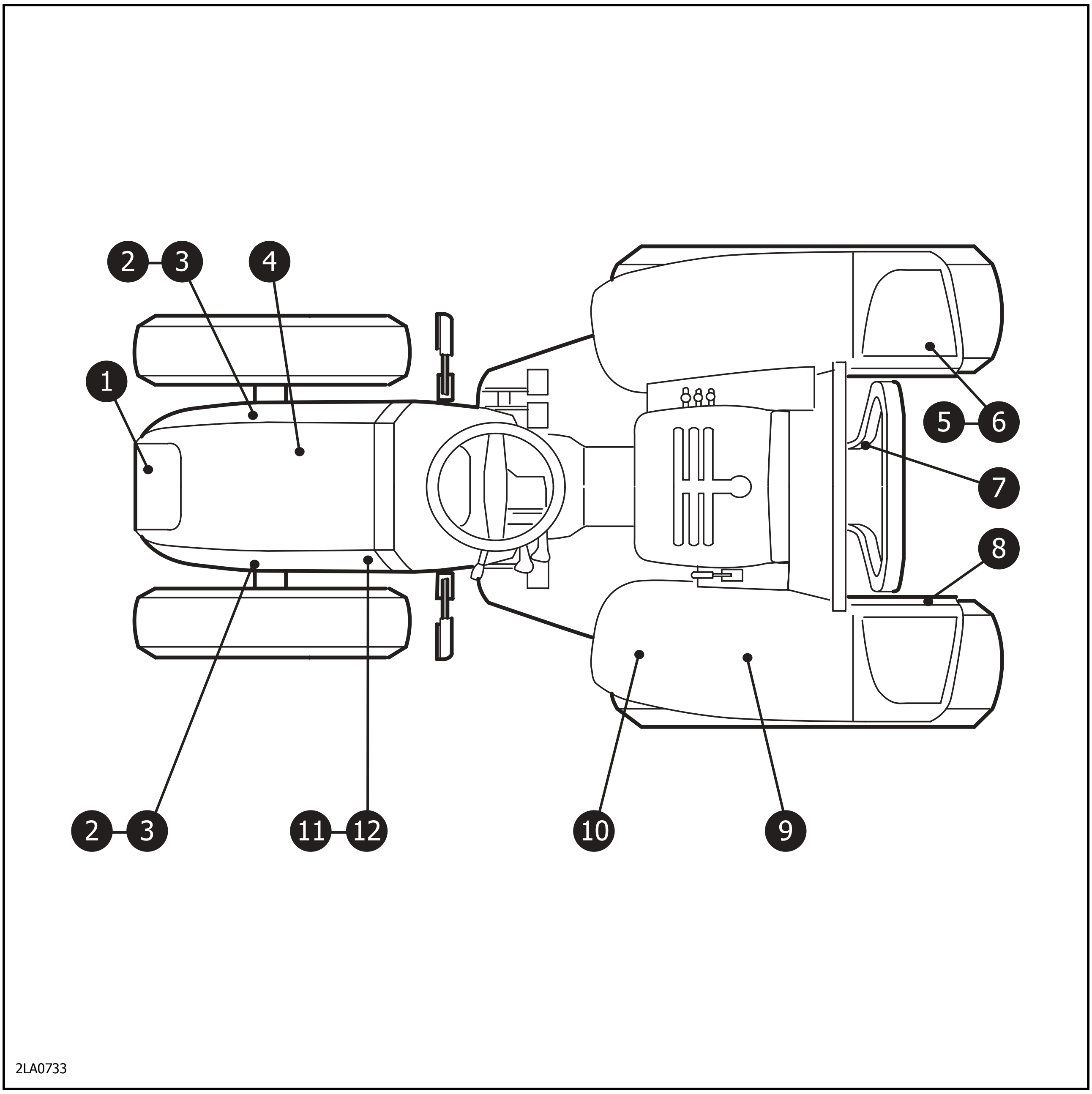
REF.	CODE	POSITION	DESCRIPTION	SYMBOL
1	**3647 158 M1**	Positioned near the battery cover.	**WARNING:**Danger of electric shock. Always disconnect the negative battery terminal before removing the battery or before servicing the electrical system.	
2	**3559 556 M1**	Positioned on the left and right sides of the radiator.	**WARNING:**Danger of entanglement. Keep your hands well clear of the fan blades when the engine is running. Always keep the guards and screens mounted.	
3	**3559 559 M1**	Positioned on both sides of the radiator.	**WARNING:** Very hot surfaces. The hands and fingers could be scorched. Warning: keep well clear of hot parts. Keep at a safety distance. **WARNING:**Danger of entanglement. Keep your hands well clear of spinning parts. Take care not to become entangled in the belts or pulleys whilst the engine is running. Keep the guards in place.	

REF.	CODE	POSITION	DESCRIPTION	SYMBOL
4	**4203 963 M1**	Positioned under the cover of the radiator plug.	**DANGER.** Jets of hot steam or hot water. Protect the face. The radiator will be under pressure when the engine is hot. Remove the plug with caution when the engine is cold.	
5	**3559 557 M1**	Affixed to the bonnet.	**DANGER.** The tractor could overturn and crush the chest. Hold firmly on to the steering wheel if the tractor is overturning. DO NOT leave your seat or jump out of the tractor.	
6	**3559 558 M1**	Affixed to the dashboard.	**WARNING:** Take care. Consult the operation and maintenance manual for information about safety and how to use the tractor.	
7	**3647 033 M1**	Affixed to the safety frame on footstep tractors.	**WARNING:** Danger of overturning and crushing. Always keep the safety frame mounted. NEVER work, NEVER remove, NEVER overturn, NEVER bend, NEVER repair and NEVER con-nect any implement to the safety frame. When necessary, only lower or remove the safety frame for servicing work. In this case, drive with the utmost care as the frame will no longer provide any protection.	

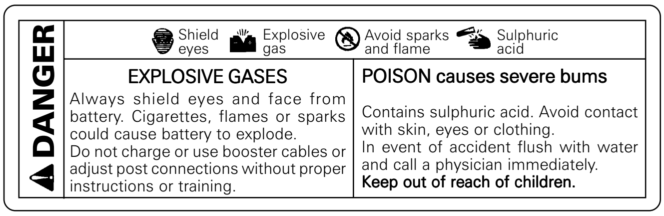
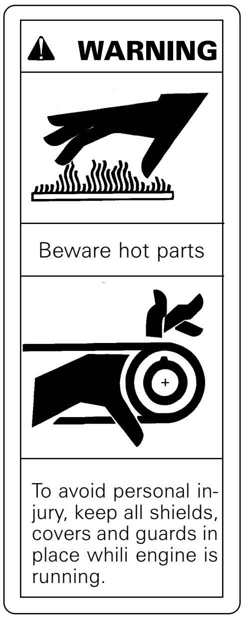
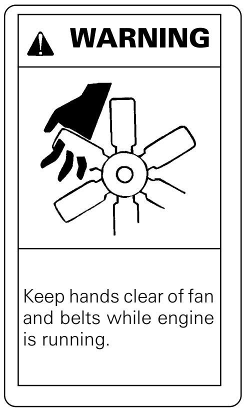
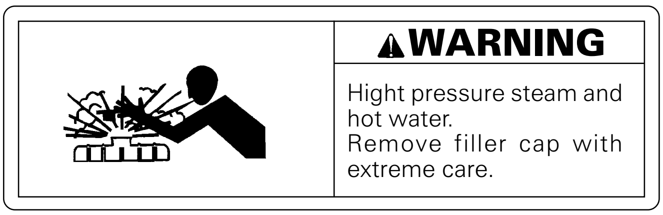
REF.	CODE	POSITION	DESCRIPTION	SYMBOL
8	**3559 553 M1**	Positioned on the inside of the left mudguard.	**DANGER.**Danger of entanglement. Keep well away from spinning shafts. Take care NOT to get caught up by the PTO driveline. Keep all the guards mounted on the transmission shafts of the tractor or implements.	
9	**3648 447 M1**	Affixed to the safety frame on tractors with seat belts.	**WARNING:**Danger of being crushed. Always wear the seat belt when the safety frame is in the vertical position.	
10	**3647 032 M1**	On the rear left mudguard on tractors without 2nd passenger seat and for tractors with safety frames.	**WARNING:**Danger of being crushed. DO NOT allow anyone to sit on the mudguards or on any other part of the tractor or towed implements.	
11	**4203 962 M1**	On the left mudguard.	**WARNING:**Danger of being crushed. Before leaving the tractor unattended, apply the parking brake, lower the implement, stop the engine and remove the ignition key. If the engine must be left running, apply the parking brake, lower the implement and move the reverse shuttle lever to the neutral position.	

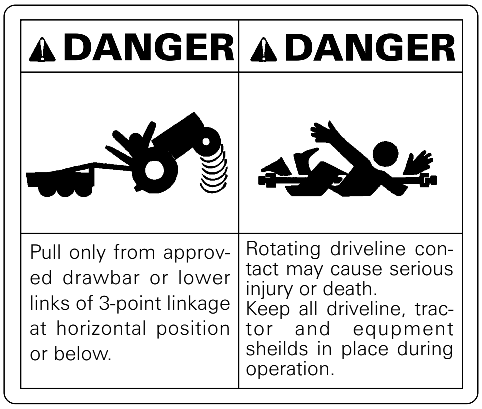
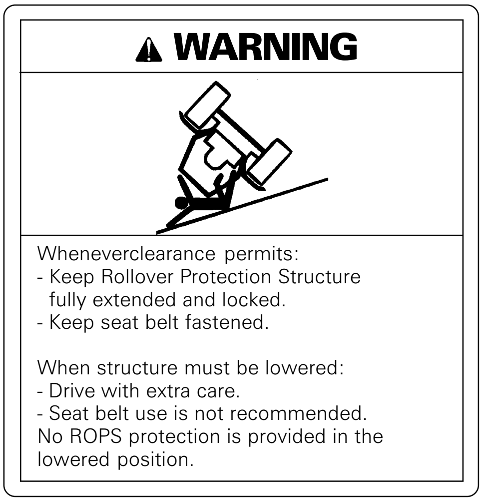
REF.	CODE	POSITION	DESCRIPTION	SYMBOL
12	**3647 157 M1**	Positioned near the dashboard or battery.	**WARNING:** Risk of causing damage. Read the operation and maintenance manual before proceeding with any work on the tractor.	
13	**3559 555 M1**	On the starter motor.	**WARNING:** Electrocution. Always disconnect the negative battery terminal before removing the cover of the solenoid and before servicing the electrical system.	
14	**3648 152 M1**	On the starter motor.	**DANGER.**Danger of being crushed. DO NOT start the engine by shorting across the terminals of the starter motor. This operation will place your life in danger. Only start the engine when you are sitting in the driving seat.	

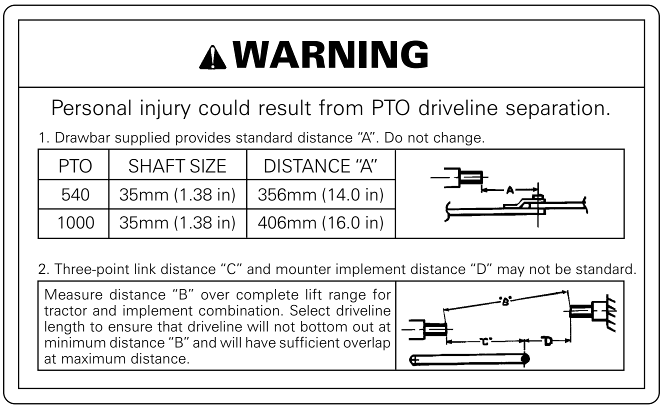
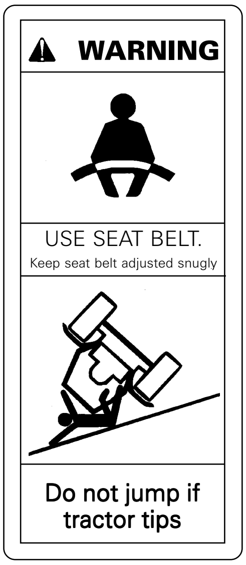
Positions of the danger decals – NAO markets

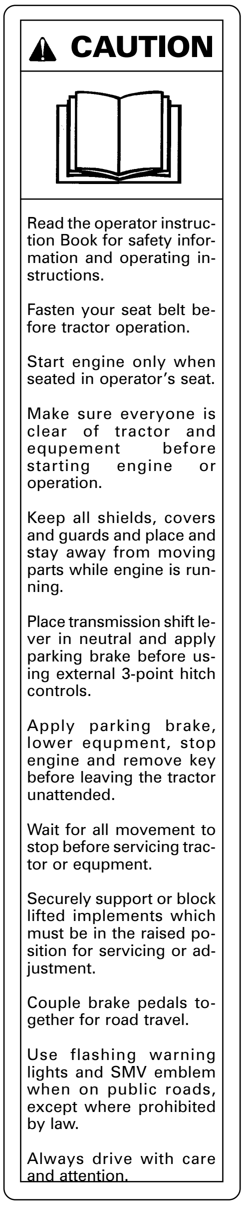
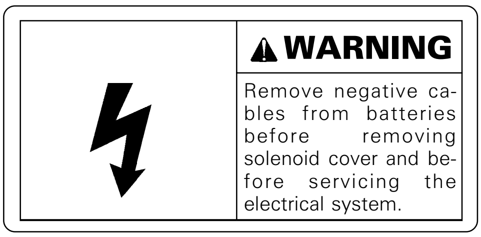
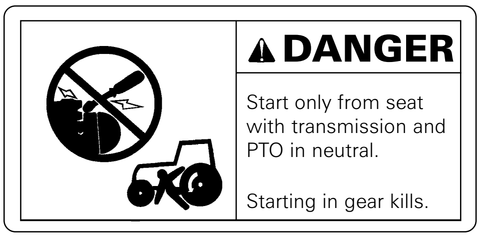


Positions of the danger decals
Complete set of danger decals NAO 3558702M95

<table>
<tr><th>REF.</th><th>CODE</th><th>POSITION</th><th>SYMBOL</th></tr>
<tr><td>1</td><td>3558 711 M1</td><td>Located near the battery cover.</td><td>
</td></tr>
<tr><td>2</td><td>3558 706 M1</td><td>Located on right and left-hand side of radiator, or on the air conveyor.</td><td>
</td></tr>
<tr><td>3</td><td>3558 712 M1</td><td>Located right and left-hand side of radiator.</td><td>
</td></tr>
<tr><td>4</td><td>3558 708 M1</td><td>Located near the battery cap.</td><td>
</td></tr>
</table>

<table>
<tr><th>REF.</th><th>CODE</th><th>POSITION</th><th>SYMBOL</th></tr>
<tr><td>5</td><td>3558 710 M1</td><td>Located inside cab on the left hand pillar or on the rear fender for footstep tractors.</td><td>WARNING
Serious personal injury or machine damage may result from overspeed of PTO driven equipment.
Select tractor PTO speed to match implement specified speed.
Do not operate PTO above recommended maximum speed.
Nominal Maximum
540 630
1000 1170</td></tr>
<tr><td>6</td><td>3558 704 M1</td><td>Located at rear of cab on the rear fender.</td><td>
</td></tr>
<tr><td>7</td><td>3647 053 M1</td><td>Located on the safety ROPS for footstep tractors.</td><td>
</td></tr>
</table>

REF.	CODE	POSITION	SYMBOL
8	**3558 709 M1**	Located at rear of cab on the inner side of the left fender.	
9	**3558 707 M1**	Located inside cab or on the right fender for footstep tractors.	

REF.	CODE	POSITION	SYMBOL
10	**3558 703 M1**	Located inside cab or on the left-hand fender for platform tractors.	
11	**3558 705 M1**	Located on the starter motor.	
12	**3648 153 M1**	Located on the starter motor.	

SEALING AND FIXING SEALANTS

Apply the sealants given in the table to the surfaces to couple.

Prepare the surfaces in the following way before applying the sealants:

- remove any deposits with a metal brush;
- thoroughly degrease the surfaces with one of the following detergents: trichloroethylene, wash oil or water and soda.

DENOMINATION		TYPE	USE
Threaded couplings locking and sealing	Weak locking	Loctite 222	Weak locking and sealing of screws, adjuster screws.
	Medium-strong thread locking	Loctite 242	Medium-strong locking and sealing of threaded parts in general.
	Strong thread locking	Loctite 270	Highly resistant fixing, locking and sealing of stud bolts, nuts, screws.
	Penetrating thread locking	Loctite 290	Capillary locking and sealing of already mounted parts. Microporosity sealing.
Smooth couplings	Locker	Loctite 601	Highly resistant fixing of coupling surfaces.
	Fixer	Loctite 641	Medium-strong resistance fixing of bushes, bearings, etc. Demounting possible using normal tools.
	Super-locker	Loctite 638	Highly resistant fast fixing of cylindrical parts. Dynamic work.
	High-temperature locker	Loctite 648	Fast fixing of cylindrical parts highly resist-ant to heat.
Hydraulic unions.	Hydraulic-hermetic	Loctite 542	Sealing of threaded unions on hydraulic or pneumatic pipes up to ¾" in diameter
	Pipe-hermetic	Loctite 572	Sealing of threaded unions in general.
Sealing of surfaces	Thick flat-hermetic	Loctite 510	Sealing of flat surfaces. Manual application.
	Flat-hermetic	Loctite 573	Sealing of precise flat surfaces. Applied by hand or by screen-print systems.
Engine	Hermetic plastic – spray type	Perkins power part hylomar	Sealing of cylinder head surfaces.
	Hermetic – paste type		Sealing of sump surfaces, covers.

LUBRICANTS AND FUELS

Component supplied	Quantity dm^3 (litres) MISTRAL AMERICA 40	45	50	Specifications	Ambient temperature	SINCLAIR	MOBIL	ESSO	SHELL	BP	LAND OIL	AGIP
				SAE CD	Below 0°C	HY VIS HD EXTRA S3 Plus 10 W	DELVAC 1310	Essolube D / 3 Plus 10 W	RIMULA CT Oil 10 W	BP Vanellus C3 10 W	HDL S3 10 W	DIESEL SIGMA 10W
				API CD - SF API CE - SF	from 0 to 27°C	HY VIS HD EXTRA S3 Plus 20 W 20	DELVAC 1320	Essolube D / 3 Plus 20 W	RIMULA CT Oil 20 W	BP Vanellus C3 20 W	HDL S3 20 W 20	DIESEL SIGMA 20W
Engine with filter	4.7	5.8	5.8	MIL-L-2104D MIL-L-2104E	Over 27°C	HY VIS HD EXTRA S3 Plus 30	DELVAC 1330	Essolube D / 3 Plus 30 W	RIMULA CT Oil 30 W	BP Vanellus C3 30 W	HDL S3 30	DIESEL SIGMA 30
				CCMCD2/D4				Essolube XD / 3 EXTRA	Universal Farm	BP Super tractor Oil Universal	UNILAND 15 W 40	SIGMA TURBO UMITRACOTR S
					Any temperature	HY VIS HD EXTRA S3 Plus 15 W 40	Mobiland Super Universal	Unifarm	Oil Shell Agroma	-	SUPERLAND UNIVERSAL 15 W 40	SUPER TRACTOR UNIVERSAL
Change (1) steering and hydraulic circuits and rear final drives.	24	24	24	API GL 4 MF 1135	Any temperature	TRANSFLUID AS/B	Mobilfluid 422 (1)	Torque fluid 62 (1)	Donax TD (1)	Tractran 8 (1)	LOT OTRAS/B (1)	ROTRA MULTITHT
Front axle and front final drives	3.5	3.5	3.5	API GL 5 MIL-L-2105D	Any temperature EP 90 - 140	HD GEAR OIL MOBILUBE HD 90	MOBILUBE GX 90 GP 80 W 90	GEAR OIL HD 80 W 90	SPIRAX Oil 80 W 90	BP Hypogear 80 W 90	LOT CX	ROTRA HP
Cooling circuit	2.0	2.7	2.7	AGROLUBE MANTOS Antifreeze fluid in the following percentages				Degrees °C	-8°	-15°	-25°	-35°
								%	20	30	40	50
Fuel tank	50	50	50	Decanted and filtered diesel fuel				ISO 8217 DMA, SB2869 A1 or A2 (cetane N.: 45 min)				

(1) Use only lubricants that comply with MF, FORD ESEM M 2 86 A and B, M-F 1135 specifications, with additives and anti-noise properties. The use of different types of oil, or mixing other types of oil into the oil supplied with the tractor can lead to increased noise.

CONVENTIONAL UNITS OF MEASUREMENT

Units of measurement (international system)

Force in (Newtons)	Conversion:	1 N = 0.1019 kg 1 kg = 9.81 N	
Power in kW (kilowatts)	Conversion:	1 kW = 1.36 HP 1 kW = 1.34 HP 1 CV = 0.736 kW 1 HP = 0.986 HP 1 HP = 0.746 kW 1 HP = 1.014 HP	Other units of measurement used: HP (Horsepower) HP (Horsepower)
Torque in Nm (Newton meter)	Conversion:	1 Nm = 0.1019 kgm 1 kgm = 9.81 Nm 1 kgm = 10 Nm *	
Specific consumption in g/kWh (grams per kilowatthour)	Conversion:	1 g/kWh = 0.736 g/HPh 1 g/HPh = 1.36 g/kWh	Other units of measurement used: g/HPh (grams per horsepower hour)
Pressure in kPa (kilopascal)	Conversion:	1 kg/cm^2 = 1 Atm 1 kg/cm^2 = 98.1 kPa 1 kg/cm^2 = 0.981 bar 1 kg/cm^2 = 1 bar * 1 kg/cm^2 = 14.22 psi 1 bar = 100 kPa 1 bar = 1.02 kg/cm^2 1 bar = 14.51 psi 1 psi = 6.9 kPa 1 psi = 0.069 bar 1 psi = 0.0703 kg/cm^2 1 kPa = 0.145 psi 1 kPa = 0.0102 kg/cm^2 1 kPa = 0.01 bar	Other units of measurement used: kg/cm^2 (kilogram/square centimeter) Atm (Technical atmosphere) psi (Pounds per square inch)

* For the sake of simplicity, the Nm and bar units are converted according to ratios 10:1 and 1:1.

Conversion values for Imperial measurement system

0.1 mm	= 3.937 mils
1 mm	= 0.039 inch
1 m	= 3.281 ft
1 km	= 0.621 miles
1 cm^3	= 0.061 cu.in
1 l	= 1.759 pts (0.88 imp. qts)
1 bar	= 14.5038 psi
1 g	= 0.035 oz. (0.564 dr)
1 kg	= 2.205 lbs
1 t	= 1.102 short ton (0.9842 long ton)
0° C	= 32° F
(In the case of temperature differences 1 °C = 1.8 °F)	

STANDARD DRIVING TORQUE VALUES

Screws with metric threads

Maximum driving torque values for metric threads in kgm.

Diameter x pitch d x p (mm)	Class 8.8 screw			Class 10.9 screw			Class 12.9 screw		
	Normal	Galva-nized	Cadmium plated	Normal	Galva-nized	Cadmium plated	Normal	Galva-nized	Cadmium plated
3x5	0.153	0.137	0.122	0.193	0.173	0.15	0.234	0.21	0.187
4x0.7	0.316	0.284	0.252	0.438	0.394	0.35	0.53	0.477	0.424
5x0.8	0.612	0.55	0.49	0.87	0.78	0.69	1.03	0.93	0.82
6x1	1.06	0.95	0.85	1.48	1.33	1.18	1.78	1.60	1.42
8x1.25	2.51	2.25	2.00	3.54	3.18	2.83	4.24	3.02	3.39
8x1	2.65	2.38	2.12	3.73	3.35	2.98	4.47	4.03	3.57
10x1.5	5.11	4.60	4.08	7.19	6.47	5.75	8.63	7.76	6.90
10x1.25	5.34	4.81	4.27	7.51	6.75	6.00	9.02	8.11	7.21
12x1.75	8.65	7.78	6.02	12.14	10.92	9.71	14.59	13.13	11.67
12x1.25	9.24	8.32	7.39	12.95	11.66	10.36	15.61	14.05	12.48
14x2	13.77	12.39	11.01	19.38	17.44	15.50	23.26	20.93	18.60
14x1.5	14.59	13.13	11.67	20.61	18.55	16.48	24.69	22.20	19.75
16x2	20.91	18.82	16.72	29.38	26.44	23.50	35.30	31.77	28.24
16x1.5	21.83	19.65	17.46	30.81	27.73	24.64	36.93	33.24	29.54
18x2.5	28.87	25.98	23.09	40.61	36.55	32.48	48.77	43.69	39.00
18x1.5	31.42	28.28	25.13	44.28	39.85	35.42	53.06	47.75	42.44
20x2.5	40.81	36.73	32.64	57.34	51.61	45.87	68.77	61.89	56.00
20x2.5	40.81	36.73	32.64	57.34	51.61	45.87	68.77	61.89	56.00
20x1.5	43.97	39.58	35.17	61.93	55.74	49.54	74.28	66.25	59.42
22x2.5	54.23	48.85	43.42	76.32	68.69	61.05	91.53	82.37	73.22
22x1.5	58.26	54.43	46.60	81.93	73.74	65.54	98.36	88.53	78.68
24x3	70.51	63.45	56.40	99.08	89.17	79.26	119.33	107.44	95.50
24x2	74.53	67.13	59.67	105.10	94.59	84.08	125.51	112.95	100.40
27x3	100.36	92.75	82.44	144.89	130.40	115.91	173.46	156.12	138.76
27x2	109.18	98.26	87.34	153.06	137.75	122.44	183.67	165.30	140.97
30x3.5	130.79	125.81	111.03	198.93	177.24	157.54	235.71	212.14	183.60
30x2	151.02	135.91	120.81	212.24	191.02	169.79	254.08	228.67	203.26

Nuts with metric threads

Maximum driving torque values for metric threads in kgm.

Diameter x pitch d x p (mm)	Standard nuts galvanized		Dropped nuts galvanized		Diameter x pitch d x p (mm)	Standard nuts galvanized		Dropped nuts galvanized	
	MAT. 5S	MAT. 8G	MAT. 5S	MAT. 8G		MAT. 5S	MAT. 8G	MAT. 5S	MAT. 8G
5x0.8	0.55	-	0.35	-	**18x2.5**	27.00	39.00	17.00	24.50
6x1	0.95	1.30	0.60	0.80	**18x1.5**	30.50	42.50	19.00	26.50
8x1.25	2.30	3.20	1.40	2.00	**20x2.5**	30.50	54.00	19.00	34.00
8x1	2.50	3.50	1.60	2.20	**20x1.5**	42.50	60.00	26.00	37.50
10x1.5	4.60	6.40	2.90	4.00	**22x2.5**	51.00	72.00	32.00	45.00
10x1.25	4.90	6.80	3.10	4.20	**22x1.5**	57.00	80.00	36.00	50.00
12x1.75	8.00	11.00	5.00	6.90	**24x3**	66.00	93.00	41.00	58.00
12x1.25	8.80	12.50	5.50	7.80	**24x2**	72.00	100.00	45.00	63.00
14x2	12.50	18.00	7.80	11.00	**77x3**	98.00	140.00	61.00	88.00
14x1.5	14.00	19.50	8.80	12.00	**27x3**	105.00	150.00	66.00	94.00
16x2	19.50	27.50	12.00	17.00	**30x3.5**	135.00	185.00	85.00	116.00
16x1.5	21.00	29.50	13.00	18.50	**30x2**	145.00	205.00	91.00	128.00

SECTION 200

ENGINE

INDEX

GENERAL FEATURES

GENERAL FEATURES	MISTRAL AMERICA 40
Engine	
- Version/Position	3TNE88 - ELAN
- Manufacturer	Yanmar
- Cycle	diesel, four-stroke
- Injection	direct
- Number of cylinders in line	3
- Cylinder liners	formed in the crankcase
- Bore (mm)	88
- Piston stroke (mm)	90
- Total swept volume. (cc.)	1642
- Firing order	1 - 3 - 2
- Compression ratio.	18:1
- Power DIN 70020 (ISO 3046/1) (HP/kW)	34/25 (37.5/27.5)
- Top rate on load (RPM)	2800
- Idling rate (RPM)	2995
- Maximum torque (Nm)	103
- Maximum torque rate (RPM)	1800
- Idling rate (RPM)	1000
- Rotation direction	Anti-clockwise (viewed from flywheel)
- Number of main bearings	4
- Recommended diesel fuel	ISO 8217 DMA, BS 2869 A1 or A2 (cetane N.: 45 min)
- Lubrication system	Forced lubrication with trochoid pump
- Capacity of lubricating oil reservoir (litres)	4.7
- Recommended lubricating oil	See section 100
- Cooling system	Coolant/Radiator
- Capacity of cooling fluid reservoir (litres)	2.0
- Cooling fan	Fan with 6 blades, ∅ 335 mm
- Regulator	Centrifugal mechanical type (all speeds)
- Ignition system	Electrical

(continued)

GENERAL FEATURES	MISTRAL AMERICA 45
Engine	
- Version/Position	4TNE84 - ELAN
- Manufacturer	Yanmar
- Cycle	diesel, four-stroke
- Injection	direct
- Number of cylinders in line	4
- Cylinder liners	formed in the crankcase
- Bore (mm)	84
- Piston stroke (mm)	90
- Total swept volume (cc.)	1995
- Firing order	1 - 3 - 4 - 2
- Compression ratio	18:1
- Power DIN 70020 (ISO 3046/1) (HP/kW)	40/29.4 (44/32)
- Top rate on load (RPM)	2800
- Idling rate (RPM)	2995
- Maximum torque (Nm)	120
- Maximum torque rate (RPM)	1600
- Idling rate (RPM)	1000
- Rotation direction	Anti-clockwise (viewed from flywheel)
- Number of main bearings	5
- Recommended diesel fuel	ISO 8217 DMA, BS 2869 A1 or A2 (cetane N.: 45 min)
- Lubrication system	Forced lubrication with trochoid pump
- Capacity of lubricating oil reservoir (litres)	5.8
- Recommended lubricating oil	See section 100
- Cooling system	Coolant/Radiator
- Capacity of cooling fluid reservoir (litres)	2.7
- Cooling fan	Fan with 6 blades, ∅ 370 mm
- Regulator	Centrifugal mechanical type (all speeds)
- Ignition system	Electrical

(continued)

GENERAL FEATURES	MISTRAL AMERICA 50
Engine	
- Version/Position	4TNE88 - ELAN
- Manufacturer	Yanmar
- Cycle	diesel, four-stroke water cooled
- Injection	direct
- Number of cylinders in line	4
- Cylinder liners	formed in the crankcase
- Bore (mm)	88
- Piston stroke (mm)	90
- Total swept volume (cc.)	2189
- Firing order	1 - 3 - 4 - 2
- Compression ratio	18:1
- Power DIN 70020 (ISO 3046/1) (HP/kW)	45/33 (49.5/36.5)
- Top rate on load (RPM)	2800
- Idling rate (RPM)	3025
- Maximum torque (Nm)	135.8
- Maximum torque rate (RPM)	1600
- Idling rate (RPM)	1000
- Rotation direction	Anti-clockwise (viewed from flywheel)
- Number of main bearings	5
- Recommended diesel fuel	ISO 8217 DMA, BS 2869 A1 or A2 (cetane N.: 45 min)
- Lubrication system	Forced lubrication with trochoid pump
- Capacity of lubricating oil reservoir (liters)	5.8
- Recommended lubricating oil	See section 100
- Cooling system	Coolant/Radiator
- Capacity of cooling fluid reservoir (liters)	2.7
- Cooling fan	Fan with 6 blades, ∅ 370 mm
- Regulator	Centrifugal mechanical type (all speeds)
- Ignition system	Electrical

(continued)

GENERAL FEATURES	MISTRAL AMERICA		
	40	**45**	**50**
Timing system			
Type.	With overhead valves controlled by tappets		
Intake:			
- start: before T.D.C.	10° - 20°		
- end: after B.D.C.	40° - 50°		
Exhaust:			
- start: before T.D.C.	51° - 61°		
- end: after B.D.C.	13° - 23°		
Gap between valves and tappets with engine cold:			
- intake. . . . . (mm)	0.15 – 0.25		
- exhaust . . . . (mm)	0.15 – 0.25		
For further technical data about the timing system			
Fuel system			
Type.	Aspirated		
Air cleaning.	5” dry filter with two elements removable for maintenance		
Fuel pump	Yanmar		
Fuel cleaning.	Paper filter on injection pump delivery		
Control	By eccentric		
Injection pump	Yanmar		
Speed governor, at all rates, built into the pump.	Yanmar		
Automatic lead variator, built into the pump	Yanmar		
Cold starting device	Thermostarter		
For further technical data about the fuel system			
- Fixed lead	16°		
- Firing order	1 - 3 - 2	1 - 3 - 4 - 2	
Injectors.	Yanmar		
- Pressure setting. . . . . (bar)	216 - 226	196 - 206	

(continued)

GENERAL FEATURES	MISTRAL AMERICA		
	40	45	50
Lubrication			
Type	forced, by means of pump		
Oil cleaning	gauze filter (on pump intake) cartridge filter (on engine delivery)		
Oil pressure with engine at top power rate (bar)	3 - 4		
Recommended oil	See section 100		
Cooling			
Type	water, with forced circulation by centrifugal pump operated by the gears of the timing system		
Capacity of cooling fluid reservoir (l)	2.0	2.7	2.7
Cooling fan	Bladed fan, ∅ 373 mm		
Fan diameter and number of blades (mm)	335 x 6	370 x 6	
Recommended fluid	See section 100		

MAIN SPECIFICATIONS

MAIN SPECIFICATIONS	Nominal value	Value at limit of wear
Cylinder head		
Cylinder head combustion surface warp . . . . (mm)	≤ 0.05	0.15
Valve housing angle		
- Intake	120°	-
- Exhaust	90°	-
Valve housing width		
- Intake . . . . (mm)	1.07 – 1.24	1.74
- Exhaust . . . . (mm)	1.24 – 1.45	1.94
Intake valve		
- Outer diameter of valve stem . . . . (mm)	7.955 – 7.975	7.9
- Inner diameter of valve guide . . . . (mm)	8.010 – 8.025	8.1
- Assembly play between valve stem and guide . . . . (mm)	0.035 – 0.070	0.2
Exhaust valve		
- Outer diameter of valve stem . . . . (mm)	7.955 – 7.970	7.9
- Inner diameter of valve guide . . . . (mm)	8.015 – 8.030	8.1
- Assembly play between valve stem and guide . . . . (mm)	0.045 – 0.075	0.2
Valve guide projection . . . . (mm)	15	-
Depth of valve impression		
- Intake valve . . . . (mm)	0.306 – 0.506	1.0
- Exhaust valve . . . . (mm)	0.3 – 0.5	
Valve head thickness		
- Intake valve . . . . (mm)	1.244 – 1.444	0.5
- Exhaust valve . . . . (mm)	1.35 – 1.55	
Intake valve timing		
- Open b. TDC	10° - 20°	-
- Closed a. BDC	40° - 50°	
Exhaust valve timing		
- Open b. BDC	51° - 61°	
- Closed a. TDC	13° - 23°	
Valve spring		
- Free length . . . . (mm)	42	-
- Slant	-	1.1
- Tension (when compressed 1 mm in length). . . . . (kg)	2.36 (variable pitch)/3.101	-
Intake and exhaust valve play. . . . . (mm)	0.15 – 0.25	-

(continued)

MAIN SPECIFICATIONS	Nominal value (mm)	Value at limit of wear (mm)
Cylinder block		
Bore		
- Mod. MISTRAL AMERICA 45	84.000 – 84.030	84.20
- Mod. MISTRAL AMERICA 40 and 50	88.000 – 88.030	88.20
Bore - Mark L		
- Mod. MISTRAL AMERICA 45	84.020 – 84.030	84.20
- Mod. MISTRAL AMERICA 40 and 50	88.020 – 88.030	88.20
Bore - Mark M		
- Mod. MISTRAL AMERICA 45	84.010 – 84.020	84.20
- Mod. MISTRAL AMERICA 40 and 50	88.010 – 88.020	88.20
Bore - Mark S		
- Mod. MISTRAL AMERICA 45	84.000 – 84.010	84,20
- Mod. MISTRAL AMERICA 40 and 50	88.000 – 88.010	88.20
Cylinder roundness		
- Mod. MISTRAL AMERICA 45	0.00 – 0.01	0.03
- Mod. MISTRAL AMERICA 40 and 50	0.00 – 0.01	0.03
Cylindricity		
- Mod. MISTRAL AMERICA 45	0.00 – 0.01	0.03
- Mod. MISTRAL AMERICA 40 and 50	0.00 – 0.01	0.03

MAIN SPECIFICATIONS	Nominal value (mm)	Value at limit of wear (mm)
Rocker arms		
Intake and exhaust valve rocker arms		
- Outer diameter of rocker arm pin	15.966 – 15.984	15.95
- Inner diameter of rocker arm bush	16.000 – 16.020	16.09
- Assembly play between pin and bush	0.016 – 0.054	0.14
Rocker arm rod incurvation	≤ 0.03	-
Tappets		
- Outer diameter of tappet stem . . . . (mm)	11.975 – 11.990	84.20
- Inner diameter of tappet guide hole . . . . (mm)	12.000 – 12.018	88.20
- Assembly play between tappet guide and stem . . . . (mm)	0.010 – 0.043	0.12

(continued)

MAIN SPECIFICATIONS	Nominal value (mm)	Limit value of wear (mm)
Pistons		
Outer diameter of piston		
- Mod. MISTRAL AMERICA 45	83.945 – 83.975	83.90
- Mod. MISTRAL AMERICA 40 and 50.	87.945 – 87.975	87.90
Outer diameter of piston – Mark L		
- Mod. MISTRAL AMERICA 45	83.965 – 83.975	83.90
- Mod. MISTRAL AMERICA 40 and 50.	87.965 – 87.975	87.90
Outer diameter of piston – Mark ML		
- Mod. MISTRAL AMERICA 45	83.960 – 83.965	83.90
- Mod. MISTRAL AMERICA 40 and 50.	87.960 – 87.965	87.90
Outer diameter of piston – Mark MS		
- Mod. MISTRAL AMERICA 45	83.955 – 83.960	83.90
- Mod. MISTRAL AMERICA 40 and 50.	87.955 – 87.960	87.90
Outer diameter of piston – Mark S		
- Mod. MISTRAL AMERICA 45	83.945 – 83.955	83.90
- Mod. MISTRAL AMERICA 40 and 50.	87.945 – 87.955	87.90
Minimum play between piston and cylinder		
- Mod. MISTRAL AMERICA 45	0.040 – 0.070	-
- Mod. MISTRAL AMERICA 40 and 50.	0.040 – 0.070	-
Upper play		
- Mod. MISTRAL AMERICA 45	0.660 – 0.780	-
- Mod. MISTRAL AMERICA 40 and 50.	0.660 – 0.780	-
Piston and pin		
- Outer diameter of pin		
- Mod. MISTRAL AMERICA 45	25.987 – 26.000	25.90
- Mod. MISTRAL AMERICA 40 and 50	25.987 – 26.000	25.90
- Pin hole diameter		
- Mod. MISTRAL AMERICA 45	26.000 – 26.009	26.02
- Mod. MISTRAL AMERICA 40 and 50	26.000 – 26.009	26.02
- Assembly play between pin and hole		
- Mod. MISTRAL AMERICA 45	0.000 – 0.022	0.12
- Mod. MISTRAL AMERICA 40 and 50	0.000 – 0.022	0.12

(continued)

MAIN SPECIFICATIONS	Nominal value (mm)	Value at limit of wear (mm)
Piston rings		
Upper ring		
- Width of ring groove		
- Mod. MISTRAL AMERICA 45	2.065 – 2.080	-
- Mod. MISTRAL AMERICA 40 and 50	2.060 – 2.075	-
- Ring width		
- Mod. MISTRAL AMERICA 45	1.970 – 1.990	-
- Mod. MISTRAL AMERICA 40 and 50	1.970 – 1.990	-
- Minimum side play		
- Mod. MISTRAL AMERICA 45	0.075 – 0.110	-
- Mod. MISTRAL AMERICA 40 and 50	0.070 – 0.105	-
- Gap between ends		
- Mod. MISTRAL AMERICA 45	0.200 – 0.400	1.5
- Mod. MISTRAL AMERICA 40 and 50	0.200 – 0.400	1.5
2nd piston ring		
- Width of ring groove		
- Mod. MISTRAL AMERICA 45	2.035 – 2.050	-
- Mod. MISTRAL AMERICA 40 and 50	2.025 – 2.040	-
- Ring width		
- Mod. MISTRAL AMERICA 45	1.970 – 1.990	-
- Mod. MISTRAL AMERICA 40 and 50	1.970 – 1.990	-
- Minimum side play		
- Mod. MISTRAL AMERICA 45	0.045 – 0.080	-
- Mod. MISTRAL AMERICA 40 and 50	0.035 – 0.070	-
- Gap between ends		
- Mod. MISTRAL AMERICA 45	0.200 – 0.400	1.5
- Mod. MISTRAL AMERICA 40 and 50	0.200 – 0.400	1.5

(continued)

MAIN SPECIFICATIONS	Nominal value (mm)	Value at limit of wear (mm)
Piston rings		
Oil scraper ring		
- Width of ring groove		
- Mod. MISTRAL AMERICA 45	4.015 – 4.030	-
- Mod. MISTRAL AMERICA 40 and 50	4.015 – 4.030	-
- - Ring width		
- Mod. MISTRAL AMERICA 45	3.970 – 3.990	-
- Mod. MISTRAL AMERICA 40 and 50	3.970 – 3.990	-
- Minimum side play		
- Mod. MISTRAL AMERICA 45	0.025 – 0.060	-
- Mod. MISTRAL AMERICA 40 and 50	0.025 – 0.060	-
- Gap between ends		
- Mod. MISTRAL AMERICA 45	0.200 – 0.450	1.5
- Mod. MISTRAL AMERICA 40 and 50	0.200 – 0.400	1.5

MAIN SPECIFICATIONS	Nominal value (mm)	Value at limit of wear (mm)
Connecting rods		
Connecting rod pivot side		
- Inner diameter of connecting rod pivot bush	51.000 – 51.010	-
- Thickness of connecting rod pivot bearing	1.492 – 1.500	-
- Outer diameter of connecting rod pivot	47.952 – 47.962	47.91
- Assembly play between pivot and bearing	0.038 – 0.058	0.16
Pin side		
- Inner diameter of pin bush	26.025 – 26.038	26.10
- Outer diameter of pin.	25.987 – 26.000	25.90
- Assembly play between pin and bush	0.025 – 0.051	0.2
Twist and parallelism	< 0.03 every 100 mm	0.08

(continued)

MAIN SPECIFICATIONS	Nominal value (mm)	Value at limit of wear (mm)
Camshaft		
Gear side		
- Outer diameter of camshaft main journal	44.925 – 44.950	44.85
- Assembly play between journal and housing	0.040 – 0.130	-
Intermediate		
- Outer diameter of camshaft main journal	44.910 – 44.935	44.85
- Assembly play between journal and housing	0.065 – 0.115	-
Flywheel side		
- Outer diameter of camshaft main journal	44.925 – 44.950	44.85
- Assembly play between journal and housing	0.050 – 0.100	-
Incurvation	≤ 0.02	0.05

MAIN SPECIFICATIONS	Nominal value (mm)	Value at limit of wear (mm)
Drive shaft		
Main journal		
- Outer diameter of main journal	53.952 – 53.962	53.91
- Thickness of main bearing.	1.995 – 2.000	-
- Assembly play between main journal and bush	0.038 – 0.068	0.15
Incurvation	≤ 0.02	-
MAIN SPECIFICATIONS	**Nominal value (mm)**	
Float		
Drive shaft float	0.090 – 0.271	
Camshaft float	0.05 – 0.25	
Connecting rod float	0.2 – 0.4	
Intermediate gear float	0.1 – 0.3	
Float for injection pump, intermediate gear, camshaft and drive shaft gears	0.07 - 0.15	
Lubricating oil pump float	0.11 – 0.19	

(continued)

MAIN SPECIFICATIONS	Nominal value
Engine lubrication circuit	
Lubricating oil pump delivery volume	
- Operation at high speed . . . .(l/min)	25.0 (at 3600 RPM)
- Operation at low speed . . . .(l/min)	8.0 (at 800 RPM)
Pressure monitoring valve opening pressure. . . . . (bar)	3.0 – 4.0
Operating pressure of lubricating oil pressure switch. . . . . (bar)	0.4 – 0.6

MAIN SPECIFICATIONS	Nominal value
Engine cooling circuit	
Coolant pump delivery volume (at 3220 - 3280 RPM) . . . .(l/min)	70
Thermostatic valve opening temperature	
- Opening temperature. . . . . (°C)	69.5 – 72.5
- Lift height. . . . . (mm)	≥ 8.0 (≥ 85 °C)
Thermal switch activating temperature	
- ON. . . . . (°C)	107 - 113
- OFF . . . . (mm)	≥ 100

DRIVING TORQUES

PARTS TO TORQUE	Thread	Driving torque	
		Nm	kgm
Cylinder head fixing bolts (1).	M10 x 1.25	85.3 – 91.2	8.7 – 9.3
Connecting rod cap fixing bolts (1).	M9 x 1.0	44.1 – 54.0	4.5 – 5.5
Flywheel fixing bolts (1)	M10 x 1.25	83.4 – 88.3	8.5 – 9.0
Main bearing cap fixing bolts (1)	M12 x 1.5	96.1 – 100.1	9.8 – 10.2
Drive shaft V-pulley fixing bolts (1).	M14 x 1.5	112.8 – 122.6	11.5 – 12.5
Injector nuts (2).	M6 x 1.0	6.9 – 8.8	0.7 – 0.9
Automatic lead fixing nuts (2)	M12 x 1.75	58.9 – 68.7	6.0 – 7.0
Bearing nut nut centrifugal weights of governor (2)	M12 x 1.25	44.1 – 49.1	4.5 – 5.0
Fixing nut of high pressure diesel fuel pipe sleeve (2)	M12 x 1.5	29.4 – 34.3	3.0 – 3.5
Hex bolts (7T) and nut (2) (3)	M6 x 1	9.8 – 11.8	1.0 – 1.2
	M8 x 1.25	22.6 – 28.4	2.3 – 2.9
	M10 x 1.5	44.1 – 54.0	4.5 – 5.5
	M12 x 1.75	78.5 – 98.1	8.0 – 10.0
PT plugs (2).	1/8″	9.8	1.0
	1/4″	19.6	2.0
	3/8″	29.4	3.0
	1/2″	58.9	6.0
Pipe joining bolts (2).	M8	12.8 – 16.7	1.3 – 1.7
	M12	24.5 – 34.3	2.5 – 3.5
	M14	39.2 – 49.1	4.0 – 5.0
	M16	49.1 – 54.0	5.0 – 5.5

(1) Parts spread with lubricating oil.

(2) Parts not spread with lubricating oil.

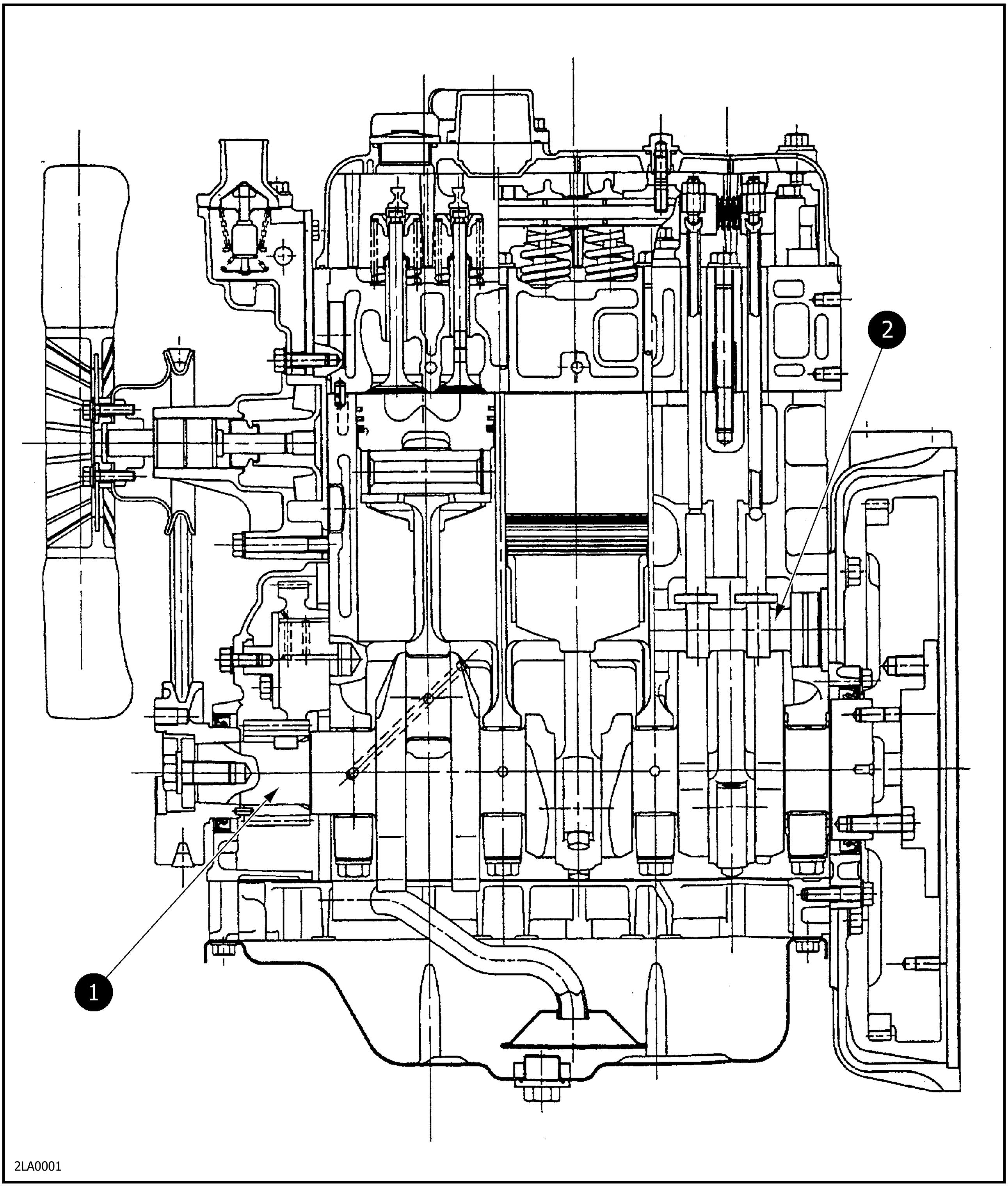
(3) a. When aluminium parts are mounted, tighten the bolts to 80% of the driving torque value given in the table.

b. 4T bolts and check nuts must be tightened to 60% of the torque value given in the table.

SPECIFIC EQUIPMENT

Code	Description
001 MT MIS	Dummy injector
002 MT MIS	Compression test equipment
003 MT MIS	Valve spring compression tool
004 MT MIS	Tool to mount the piston rings
005 MT MIS	Tool to mount the piston complete with liners
006 MT MIS	Valve guide puller
007 MT MIS	Valve guide seating tool
008 MT MIS	Puller to remove the eccentric weights of the injector regulator - MISTRAL AMERICA 40
009 MT MIS	Puller to remove the eccentric weights from the injection regulator - MISTRAL AMERICA 45/50
010 MT MIS	Bracket to support the injection pump tappets
011 MT MIS	Tool to seat the injection pump plunger
012 MT MIS	Injection pump float tool

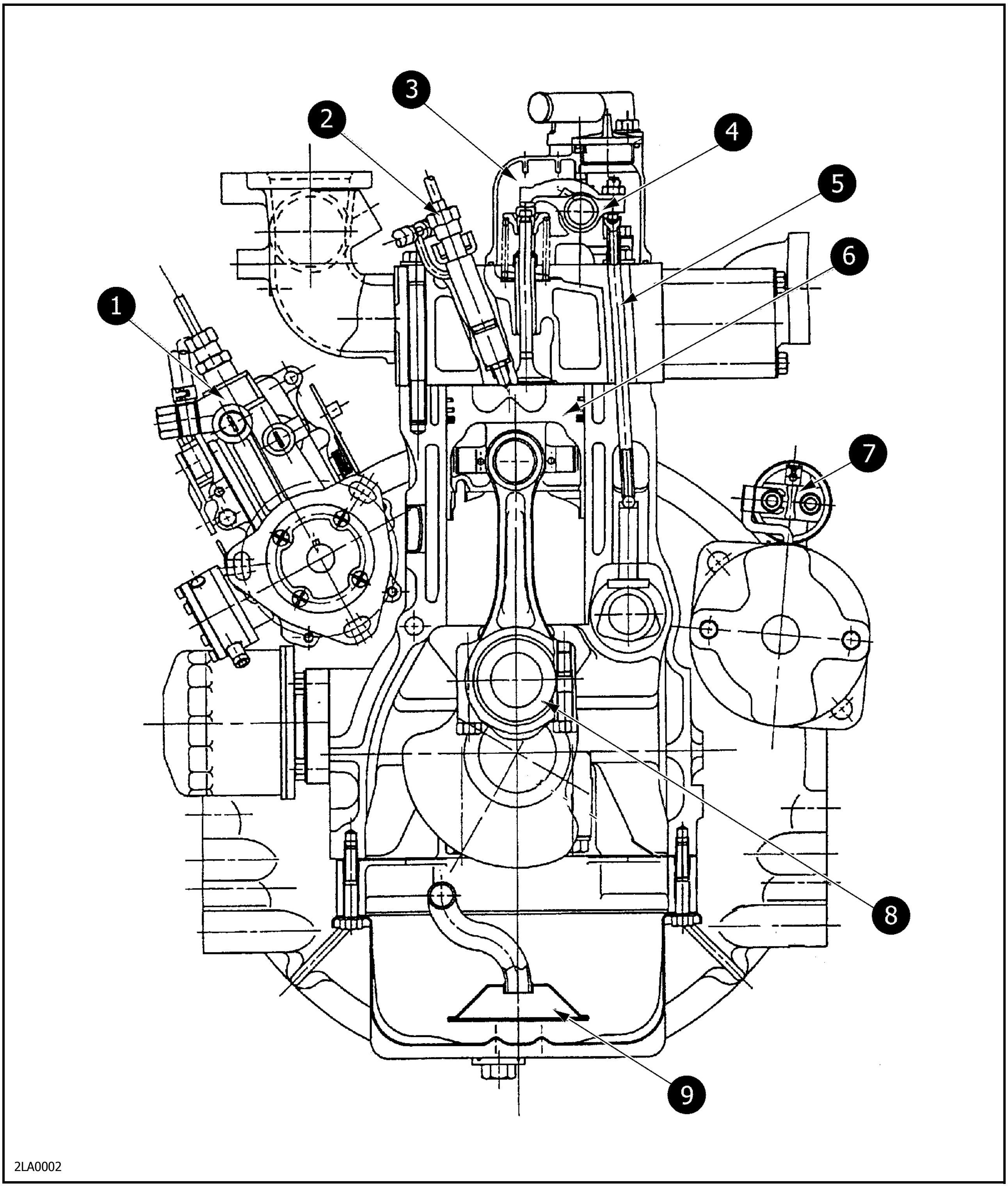
SECTIONS



1

Longitudinal section of engine (mod. MISTRAL AMERICA 40)

1. Drive shaft
2. Camshaft



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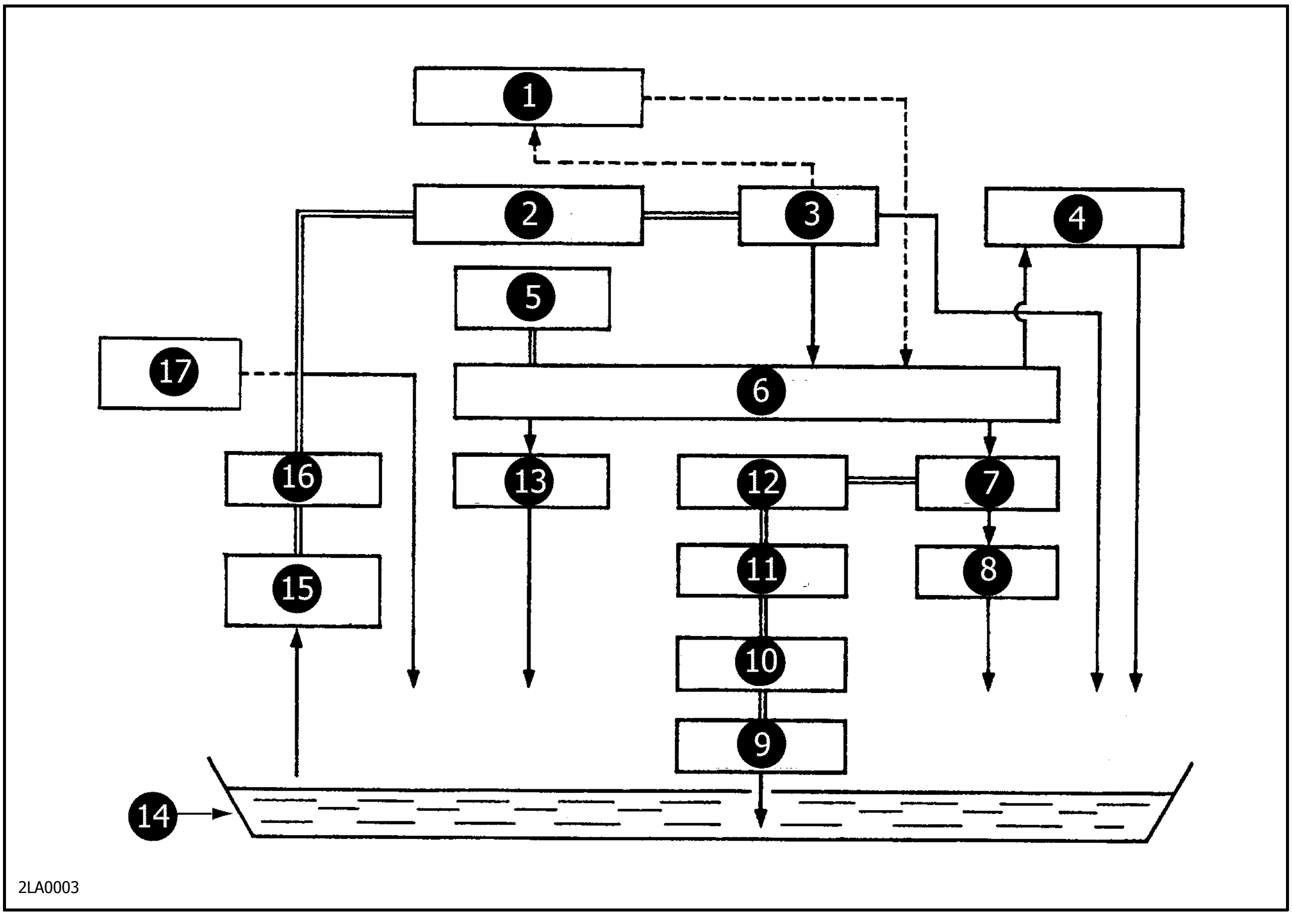
Cross-section of engine (mod. MISTRAL AMERICA 40)

1. Injection pump
2. Injector
3. Tappet cover
4. Rocker arms
5. Cylinder head
6. Piston
7. Starter motor
8. Connecting rod
9. Lubricating oil suction pipe

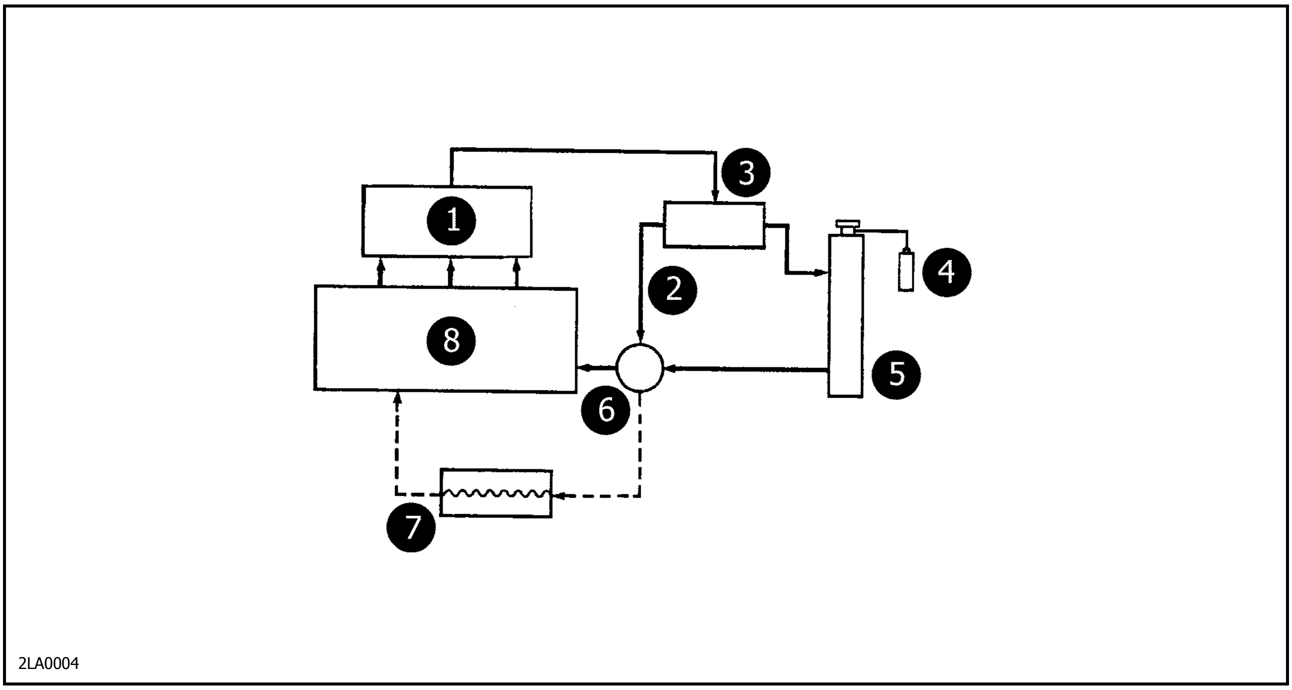
LUBRICATION, COOLING AND FUELLING CIRCUIT DIAGRAMS



3

Engine lubrication circuit diagram.

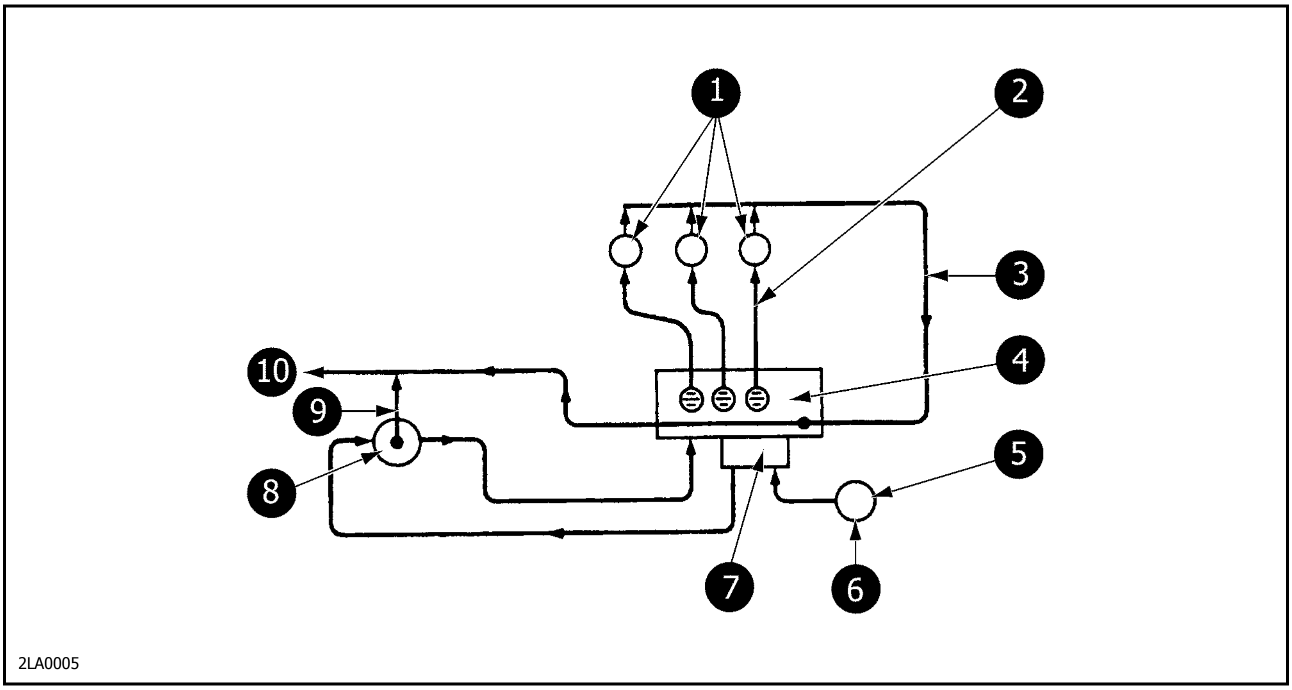
1. Heat exchanger (on request)
2. Oil filter (with bypass valve)
3. Pressure governor valve
4. Injection pump
5. Pressure switch
6. Main cylinder block duct
7. Main bearing
8. Big end bearing
9. Tappets/cam surfaces
10. Rocker arms
11. Rocker arm pin
12. Camshaft bearing
13. Intermediate gear pin
14. Oil sump
15. Oil intake pipe (with gauze filter)
16. Oil pump
17. Safety valve



4

Engine cooling circuit diagram.

1. Cylinder head
2. By-pass
3. Thermostat
4. Secondary tank
5. Radiator
6. Water pump
7. Heat exchanger for oil (on request)
8. Cylinder block



5

Engine fuelling circuit diagram.

1. Injector
2. High pressure injection tube
3. Fuel return tube
4. Injection pump
5. Oil separator (on request)
6. From fuel tank
7. Fuel pump
8. Fuel filter
9. Breather pipe
10. To fuel tank

ENGINE TROUBLESHOOTING

Faults	Possible causes	Remedies
The engine fails to start	**1.** Battery slightly low.	Check, recharge the battery and replace it if necessary.
	2. Connections to battery terminals corroded or slack.	Clean, inspect, tighten the nuts and, if necessary, replace any excessively corroded terminals and nuts.
	3. Circuit open.	Close the circuit.
	4. Intake/exhaust valve play incorrect.	Adjust valve play.
	5. Intake/exhaust valve seized.	Replace.
	6. Piston rings seized or broken.	Replace piston ring.
	7. Cylinder and piston rings worn.	Lap and use larger size parts.
	8. Big end pins and bearings seized.	Repair or replace.
	9. Foreign body in combustion chamber.	Demount and repair the chamber. Remove the foreign body.
	10. Intake/exhaust valve timing incorrect.	Adjust the valve play and check the timing of the intake/exhaust valves.
	11. Incorrect timing of injection pump on engine.	Correctly time the injection pump on engine.
	12. Impurities or water accumulated in the fuel pipes.	Detach the pipes, the injection pump and thoroughly clean them. If necessary, clean and dry the fuel tank.
	13. No fuel in tank	Fill tank.
	14. No fuel supplied to injection pump	Check and, if necessary, replace the fuel pump.
	15. Air in the fuel circuit.	Check the pipes, unions, fuel pump, filters and injection pump for air. Lastly, bleed the circuit.
	16. Starter motor damaged.	Repair or replace the starter motor.
	17. Thermostarter inefficient.	Check or replace the thermostarter.

Faults	Possible causes	Remedies
The engine starts but then stops	**1.** Idling rate too low.	Adjust idling rate.
	2. Irregular fuel supply to injection pump	Check the flow rates on the test bench.
	3. Impurities or water accumulated in the fuel pipes.	Detach the pipes, the injection pump and thoroughly clean them. If necessary, clean and dry the fuel tank.
	4. Fuel filters clogged	Replace integral filter cartridges.
	5. Abnormal play between valves and rocker arms.	Adjust play between valves and rocker arms.
	6. Valves seized, burnt or cracked.	Replace the valves.
	7. Air in the fuel circuit.	Check the pipes, unions, fuel pump, filters and injection pump for air. Lastly, bleed the circuit.
	8. Injection pump controls damaged.	Replace the damaged parts.
	9. Damaged cylinder head seal.	Replace the seal.
	10. Piston ring seized or broken.	Replace piston ring.
	11. Cylinder and piston rings worn.	Lap and use larger size parts.
	12. Big end pin and bearings seized.	Repair or replace.
	13. Incorrect alignment of piston ring gap.	Correct gap alignment.
The engine overheats.	**1.** Centrifugal pump of engine cooling circuit inefficient.	Overhaul the pump and replace it if necessary.
	2. Thermostat inefficient.	Replace the thermostat.
	3. Radiator partially inefficient.	Remove any scaling by washing. Check and repair any leaks from the tubes.
	4. Scaling in the places where coolant passes through the cylinder head and crankcase.	Thoroughly wash.
	5. The belt that controls the centrifugal pump and fan is too slack.	Check and adjust the belt tension.
	6. Cooling fluid (quantity insufficient).	Top up the level in the expansion tank using the recommended fluid.
	7. Incorrect engine timing.	Check and correctly time the engine.

(continued)

Faults	Possible causes	Remedies
	8. Injection pump with incorrect setting.	Adjust the injection pump on the test bench in compliance with the settings in the table.
	9. Air filter clogged.	Clean the unit and replace the filter element if necessary.
	10. Cylinder liners cracked	Replace.
	11. Damaged cylinder head seal.	Replace the seal.
	12. Piston rings jammed or damaged.	Replace the piston rings.
Coolant temperature too low.	**1.** The radiator's cooling capacity is excessive owing to incorrect operation of the thermostat.	Replace the thermostat.
Low engine power and irregular operation.	**1.** Incorrect timing of injection pump on engine.	Correctly time the injection pump on engine.
	2. Automatic lead variator in injection pump damaged.	Overhaul the injection pump and adjust it on the test bench in compliance with the settings in the table.
	3. Worn timing system pin.	Overhaul the injection pump and adjust it on the test bench in compliance with the settings in the table.
	4. Irregular fuel supply to injection pump	Overhaul the injection pump and adjust it on the test bench in compliance with the settings in the table.
	5. Speed governor, at all rates, damaged.	Overhaul the injection pump and adjust it on the test bench in compliance with the settings in the table.
	6. Injectors partially clogged or damaged.	Clean, overhaul and correctly calibrate the injectors.
	7. Impurities or water accumulated in the fuel pipes.	Detach the pipes, the injection pump and thoroughly clean them. If necessary, clean and dry the fuel tank.
	8. Fuel pump damaged.	Replace fuel pump.
	9. Air filter clogged.	Clean the unit and replace the filter element if necessary.
	10. Length of rod between accelerator and injection pump badly regulated.	Adjust rod length.

(continued)

Faults	Possible causes	Remedies
	11. Injection pump with maximum screw badly adjusted.	Adjust the maximum screw.
	12. Drop in engine compression due to: - jammed piston rings; - worn cylinder liners; - worn or badly adjusted valves.	Replace the damaged parts or overhaul the engine if necessary.
	13. Big end bearing and main bearing worn.	Measure or replace.
	14. Reduced cooling effect from radiator.	Defective thermostat (check/replace). Adjust fan belt tension.
	15. Insufficient cooling fluid.	Check to make sure that no water leaks from the cooling system and clean it.
	16. Wrong fan belt tension.	Adjust fan belt tension.
	17. Thermostat worn.	Check/replace.
Abnormal knocking in engine.	**1.** Injectors partially clogged or damaged.	Clean, overhaul and correctly calibrate the injectors.
	2. Impurities in the fuel pipes.	Clean the pipes and replace any that are excessively dented. Clean the injection pump if necessary.
	3. Incorrect timing of injection pump on engine.	Correctly time the injection pump on engine.
	4. The engine shaft knocks owing to excessive play on one or more main or big end bearings, or too much play in the supports.	Grind the drive shaft pins; fit larger bearings and bearing rings.
	5. Drive shaft unbalanced.	Check shaft alignment and balancing. Replace the shaft if necessary.
	6. Flywheel fixing bolts slackened.	Replace the slackened bolts and tighten all bolts to the prescribed torque value.
	7. Axes of connecting rods not parallel.	Straighten the connecting rods, check the parallelism of the axes and, if necessary, replace the connecting rods themselves.
	8. Piston knocking due to abnormal wear.	Ream the cylinder liners and fit larger pistons.

(continued)

Faults	Possible causes	Remedies
	9. Noisy piston pins owing to excessive play in the piston bosses and big end pin. Bushes free in the big end housing.	Fit a larger piston pin, true the piston bosses and big end bushes. Replace the bushes.
	10. Ticking due to noisy timing system.	Make sure that there are no broken springs, that the play between stems and guides, tappets and housings is not excessive. Adjust the play between the valves and rocker arms.
Abnormal black or dark grey smoke from the engine.	**1.** Maximum flow rate of injection pump too high.	Adjust the injection pump on the test bench in compliance with the settings in the table.
	2. The injection pump is delayed too much or the automatic lead variator is damaged.	Correctly time the injection pump on the engine or check the automatic lead variator.
	3. Too much injection pump lead.	Correctly time the injection pump on engine.
	4. Injectors partially and/or totally clogged or with incorrect setting.	Clean, overhaul and correctly calibrate the injectors; replace them if necessary.
	5. Air filter clogged.	Clean the unit and replace the filter element if necessary.
	6. Drop in engine compression due to: - jammed piston rings; - worn cylinder liners; - worn or badly adjusted valves.	Replace the damaged parts or overhaul the engine if necessary.
	7. Injection pipes damaged.	Check the condition of the pipes and replace them if necessary.
	8. Diesel fuel with the wrong specifications.	Use suitable diesel fuel.
	9. Engine used at high temperatures and altitudes.	Use a higher powered engine.
	10. Exhaust pipe clogged.	Clean pipe.
Grey smoke tending towards a whitish, grey-blue or blue colour.	**1.** The injection pump is delayed too much or the automatic lead variator is damaged.	Correctly time the injection pump on the engine or check the automatic lead variator.
	2. Injectors clogged or defective.	Clean, overhaul and correctly calibrate the injectors; replace them if necessary.
	3. Oil oozes from the piston rings owing to jammed rings or worn liners.	Replace the damaged parts or overhaul the engine if necessary.

(continued)

Faults	Possible causes	Remedies
	4. Too much lead on injection pump.	Correctly time the injection pump on engine.
	5. Oil oozes through the intake valve guide owing to worn valve stems or guides.	Overhaul the cylinder head.
	6. The engine fails to reach operating temperature (thermostat damaged).	Replace the thermostat.
	7. Piston rings incorrectly mounted/positioned.	Mount correctly.
	8. Intake/exhaust valve timing incorrect.	Adjust valve play and timing.
	9. Diesel fuel with the wrong specifications.	Use suitable diesel fuel.
	10. Water in the fuelling circuit.	Check and repair.
The engine fails to stop.	**1.** Stopping electromagnet damaged.	Replace the electromagnet.
	2. Speed governor, at all rates, damaged.	Overhaul the injection pump and adjust it on the test bench in compliance with the settings in the table.
Oscillation, instability in the rotation rate.		
- when idling	**1.** Piston rings seized or broken.	Replace the piston rings.
	2. Big end pins and bearings seized.	Repair or replace.
	3. Big end bearings and main bearings worn.	Measure or replace.
	4. Injection pump regulator damaged.	Repair or replace.
	5. Water in the fuelling circuit.	Clean and repair.
- when operating	**1.** Intake/exhaust valves seized.	Replace.
	2. Big end pins and bearings seized.	Repair or replace.
	3. Big end bearings and main bearings worn.	Measure or replace.
	4. Injection pump regulator damaged.	Repair or replace.
	5. Water in the fuelling circuit.	Clean and repair.

(continued)

Faults	Possible causes	Remedies
Excessive vibration in engine.	**1.** Intake/exhaust valves jammed.	Replace.
	2. Spring rings jammed or damaged.	Replace.
	3. Big end pin and bearings jammed.	Repair or replace.
	4. Big end bearings and main bearings worn.	Measure or replace.
	5. Big end fixing bolts slackened.	Tighten to the prescribed torque value.
	6. Injection pump regulator damaged.	Repair or replace.
	7. Excessive injection pump lead.	Check and adjust.
Excessive fuel consumption.	**1.** Loss of compression from valve housing.	Lap valve housing.
	2. Radiator cools too much.	Thermostat defective.
	3. Excessive injection pump delay	Check and adjust.
Excessive consumption of lubricating oil.	**1.** Piston rings seized or broken.	Replace.
	2. Cylinder and piston rings worn.	Lap and use larger size parts.
	3. Incorrect alignment of piston ring gap.	Correct gap alignment.
	4. Inverted assembly of piston rings	Mount correctly.
	5. Impurities in combustion chamber.	Demount and remove the impurities.
	6. Intake/exhaust valve guide worn.	Measure or replace.
	7. Lubricating oil with wrong specifications.	Use suitable lubricating oil.
	8. Leaks from lubricating oil pipes.	Repair/replace.
Water in the lubricating oil.	**1.** Damaged cylinder head housing seal.	Replace.
	2. Cylinder liners cracked	Replace.
Fuel in the lubricating oil.	**1.** Intake/exhaust valves seized.	Replace.
	2. Piston rings seized or broken.	Replace.
	3. Cylinder and piston rings worn.	Lap and use larger size parts.
Lubricating oil pressure too low.	**1.** Big end bearings and main bearings worn.	Measure/replace.
	2. Big end bolts slackened.	Tighten bolts.
	3. Cylinder liner cracked	Replace.

(continued)

Faults	Possible causes	Remedies
	4. Lubricating oil with wrong specifications.	Use suitable lubricating oil.
	5. Leaks from lubricating circuit pipes.	Repair/replace.
	6. Lubricating oil filter clogged.	Replace.
	7. Worn pressure monitoring valve.	Clean, adjust or replace.
	8. Insufficient oil capacity.	Top up to maximum oil level.
Temperature increase at exhaust.	**1.** Intake/exhaust valve play incorrect.	Adjust valve play.
	2. Loss of compression from valve housings.	Lap valve housing.
	3. Spring rings seized or broken.	Replace piston rings.
	4. Reduced cooling effect from radiator.	Check/replace thermostat. Check/adjust fan belt slip.
	5. Insufficient cooling fluid.	Check for leaks from the system/ repair.
	6. Fan belt tension incorrect.	Adjust tension.

(continued)

ENGINE SPLITTING AND REMOUNTING

Splitting

WARNING

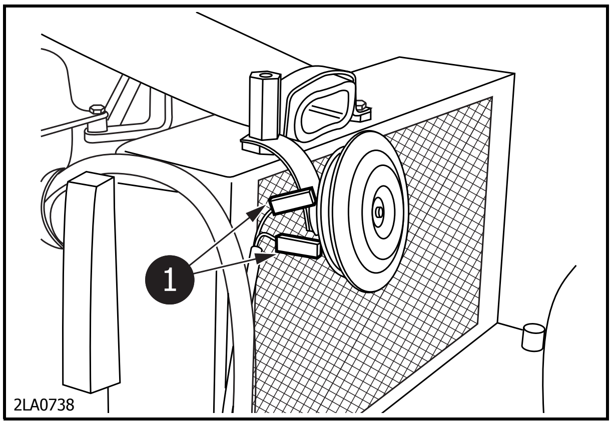
Lift and handle all heavy parts with lifting equipment of a suitable capacity.
Make sure that the units or parts are supported by appropriate harness and hooks.
Make sure that there are no bystanders near the load being lifted.

WARNING

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed in the following way:

1. Split the clutch assembly (see section 300).
2. Disconnect the electrical connection (1) from the horn.
3. Unscrew the clamps (1, 2) and remove the intake sleeve (3).



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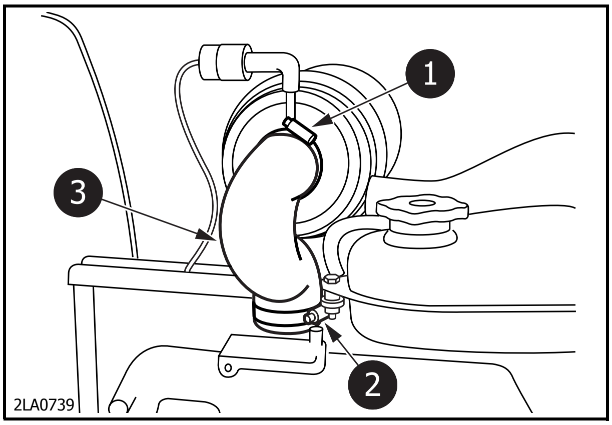

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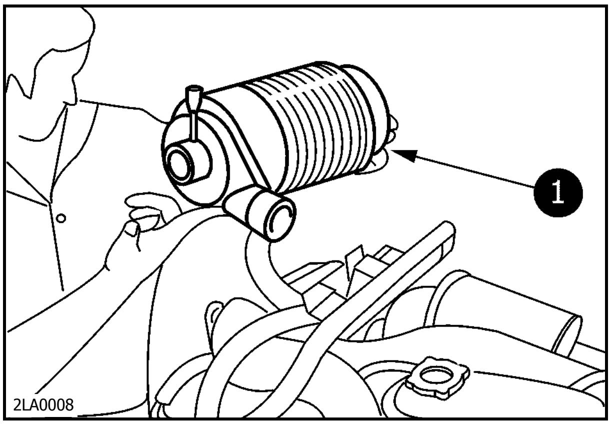
4. Remove the air intake filter (1).



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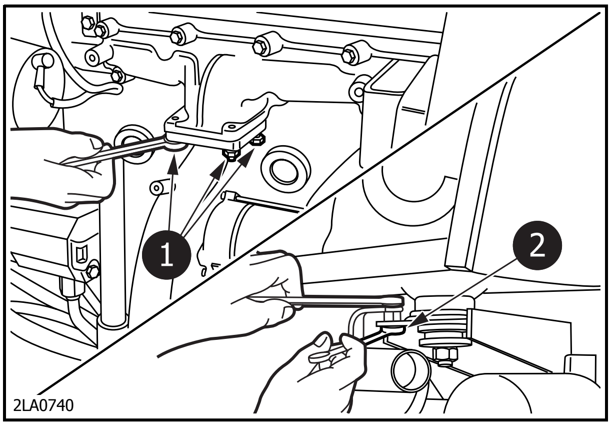
5. Unscrew the bolts (1) that fix the silencer to the exhaust manifold. Unscrew the bolt (2) that fixes the exhaust pipe under the platform and remove the exhaust pipe.



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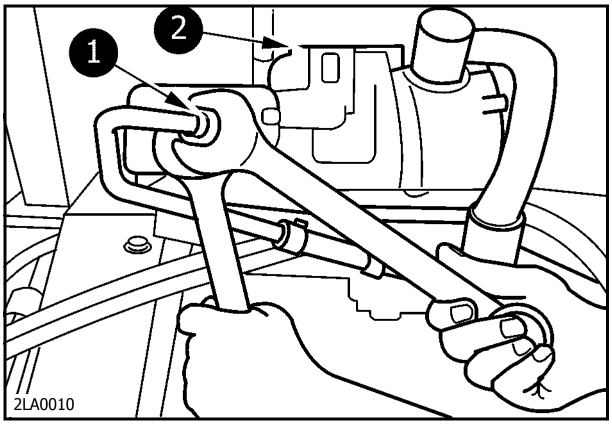
6. Disconnect the lubrication intake pipe (1) from the pump (2).



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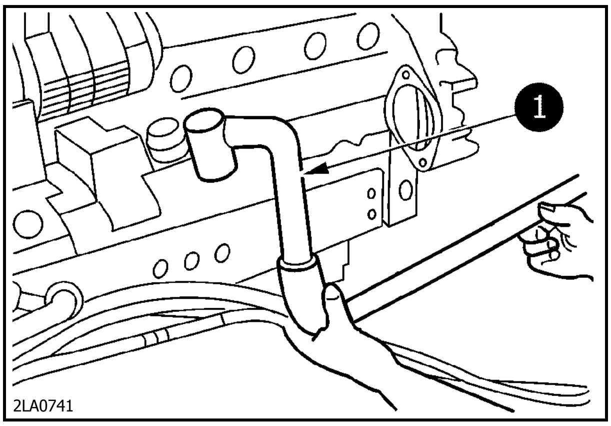
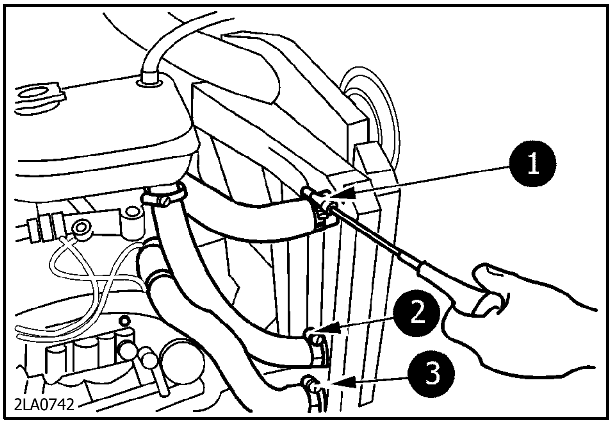
7. Disconnect the return pipe (1) of the lubrication system.



11

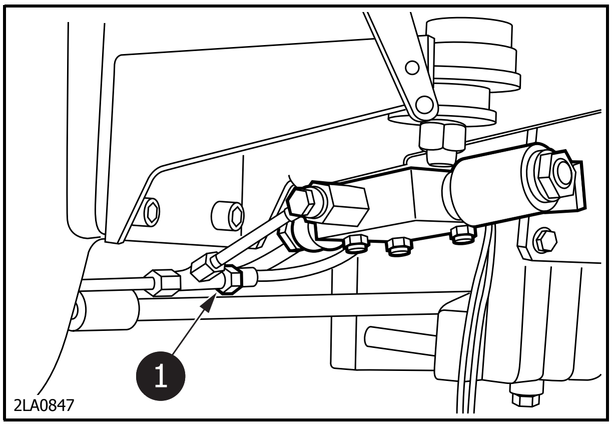
8. Unscrew the relative clamps and detach the upper (1), central (2) and lower (3) sleeves from the radiator.

9. Place two fixed stands under the axle support and one under the engine. Hook on the chains so that the engine is well balanced as it is lifted and fit two wooden chocks between the support and axle to prevent the load from swinging.



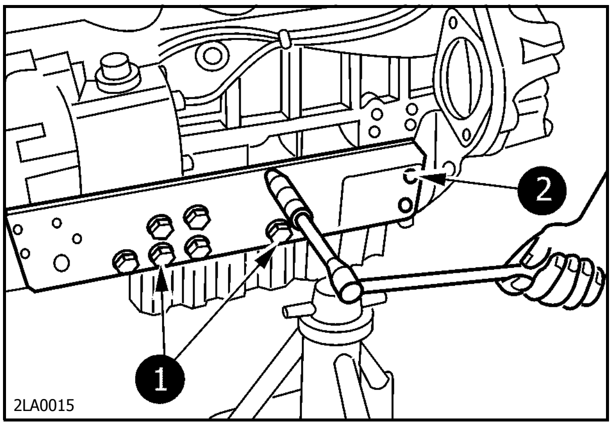
12

10. Unscrew the union (1) and detach the pipe of the front diff lock.



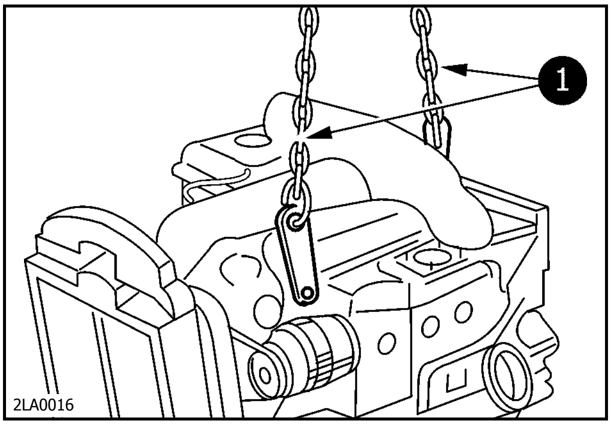
13

11. Unscrew the bolts (1) that fix the engine to the front axle support (2).



14

12. Using a hoist (1), split the engine from the support – front axle assembly.



15

WARNING Lift and handle all heavy parts with lifting equipment of a suitable capacity. Make sure that the units or parts are supported by appropriate harness and hooks. Make sure that there are no bystanders near the load being lifted.

Remounting

Bear in mind the following recommendations when remounting the engine:

WARNING Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

- Apply the driving torque values given on page 17.
- Fit the support-front axle assembly back on the engine.
- Connect the pipe of the front differential lock.
- Connect and fix the upper, central and lower sleeves of the radiator and the connection bracket.
- Connect the return pipe (1) of the lubrication system.
- Position and fix the support and filter of the transmission lubricating circuit.
- Connect the intake pipe to the lubrication system.
- Position and fix the exhaust pipe.
- Position the air intake filter.
- Mount and fix the intake sleeve.
- Connect the horn connections.
- Remount the clutch assembly (see section 300).

COMPRESSION TEST

If the engine performances are insufficient, check the compression value of each cylinder besides the injection apparatus (overhaul the atomizers and injection pump).

WARNING

Do not use matches, cigarette lighters or torches as light source near the machine as it contains inflammable fluids.

Compression degree

The compression degree is a value that indicates the quantity of air intaken and the condition of the sealing parts of the cylinder (rings and valves).

The compression value in the cylinders ensures that the cylinders themselves operate correctly in the condition where the same amount of fuel is injected per cylinder per phase.

Insufficient compression not only lowers the engine performance but also prevents the fuel from burning completely as there is not enough air to achieve a perfect combustion.

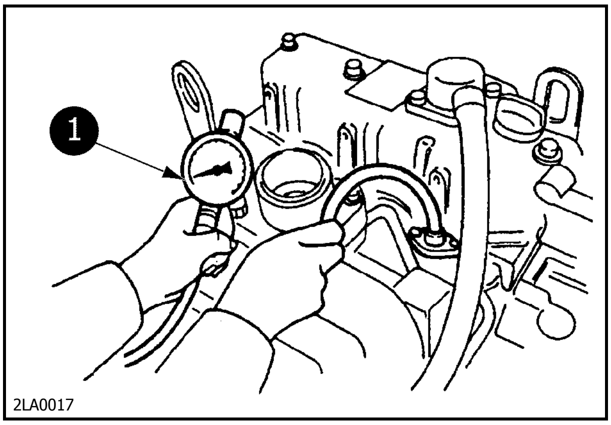
In this case, the engine will no longer operate efficiently and will consume too much fuel. This leads to smoke at the exhaust and a reduction in the exhaust orifices.

Since the compression degree **also depends on the engine temperature** (there are lower compression values with a cold engine, higher ones with a hot engine), the compression value must only be measured when the engine has reached its operating temperature.

Measuring procedure

1. Bring the engine to operating temperature.
2. Turn off the engine.
3. Turn the regulator knob to the STOP position to prevent fuel from flowing to the injectors.
4. Remove the injector that corresponds to the cylinder being examined.
5. Allow the internal combustion engine to turn over a few times by means of the starter motor in order to expel any carbon residues.
6. Mount the dummy injector **001 MT MIS** in place of the one demounted previously and fit a copper washer in between.

7. Connect the compression tester **002 MT MIS** (with an adapter and pressure gauge (1)) to the tested cylinder and take the measurements by allowing the internal combustion engine to run by means of the starter motor until the pressure gauge reading becomes stable.



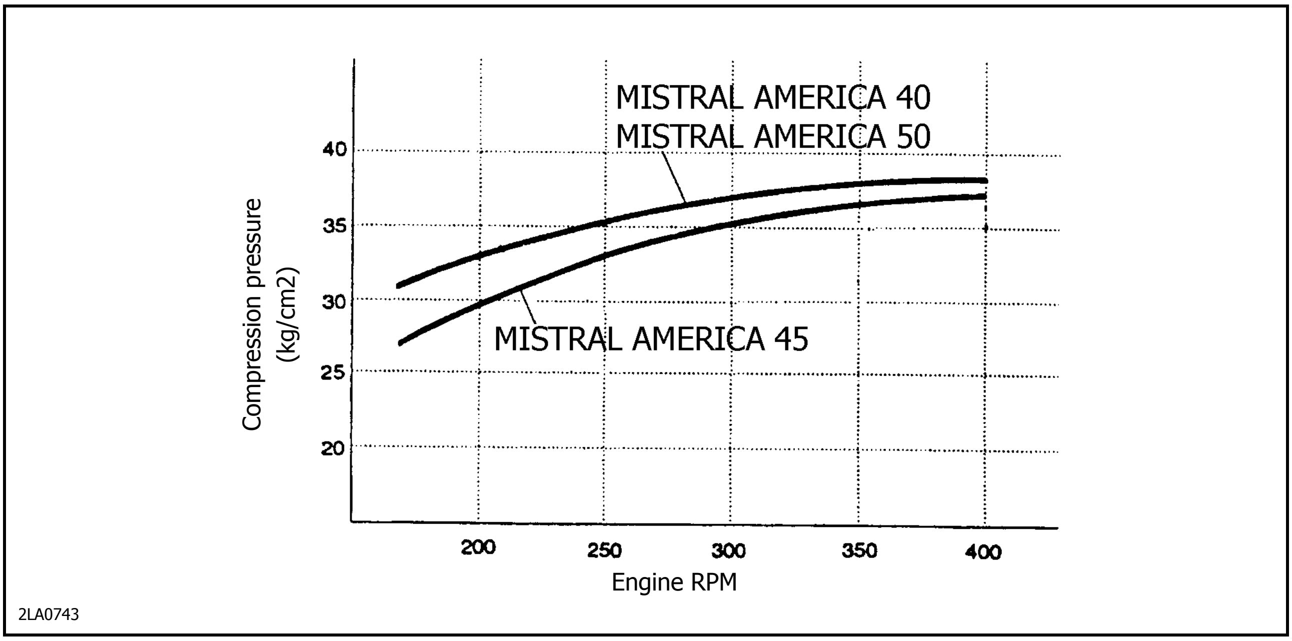
16

8. Test the compression in the remaining cylinders by repeating the previously described operations 4-5-6-7.

Compare the measured values with the ones in the table below:

Model MISTRAL AMERICA	Compression pressure at 250 RPM. (kg/cm^2)		Difference in the compression pressure off the various cylinders (kg/cm^2)
	Normal	Limit	
40	35 ± 1	28 ± 1	2 - 3
45	33 ± 1	26 ± 1	2 - 3
50	35 ± 1	28 ± 1	2 - 3

Also consider that the compression decreases by about 1% for each 100 meters of altitude above sea level and that, depending on the engine rate, the pressure variation presents the trends indicated in the fig. 17.



17

> ☞ Although the aim is to always obtain the highest compression values, the important thing is to make sure that the compression in the cylinders is uniform as this allows the engine to operate in a regular way.

It is advisable to check a second time if considerable drops in the compression in a cylinder are noted.

Before measuring, pour normal engine oil (about a spoonful) through the injector hole, into the cylinder.

Allow the engine to run so that the oil spreads over the walls of the cylinder, then repeat the test and compare the two test values obtained.

If higher values are recorded during the second test, this means that the piston rings could be worn and/or the cylinder liners could be ovalized or damaged.

If the values are not higher than the previous ones, the fault will be due to the valves.

Only a slight improvement in the compression will indicate that both the valves and piston rings are in order.

Whatever the case, also consult "Troubleshooting" on page 24 – 31.

ENGINE - OVERHAUL

Demounting

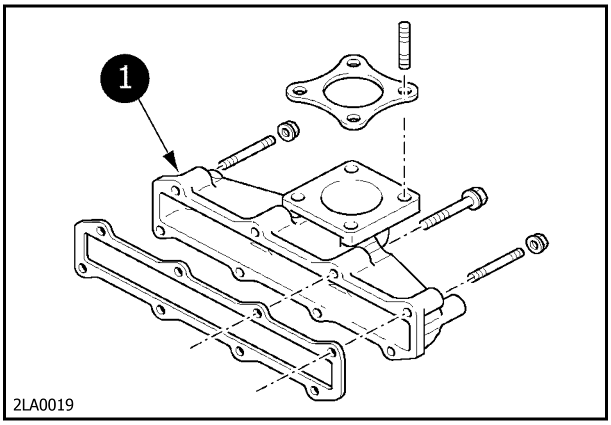
WARNING

Handle all parts with the utmost care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

The following procedure assumes that the external parts (such as the air filter, exhaust pipe and radiators, which differ as to type and installation) have already been demounted and that:

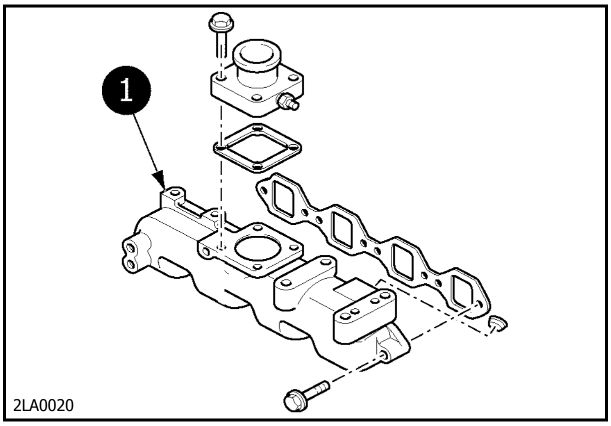
- all sand, dust and dirt have been removed from the surface of the engine;
- the lubricating oil and coolant have been drained from the engine.

1. Remove the exhaust manifold (1).



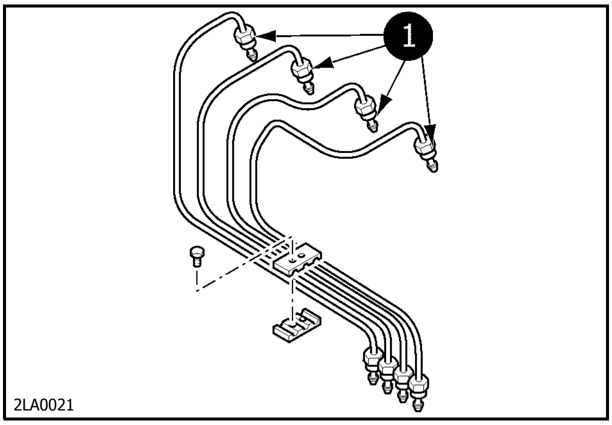
18

2. Detach the intake manifold (1).



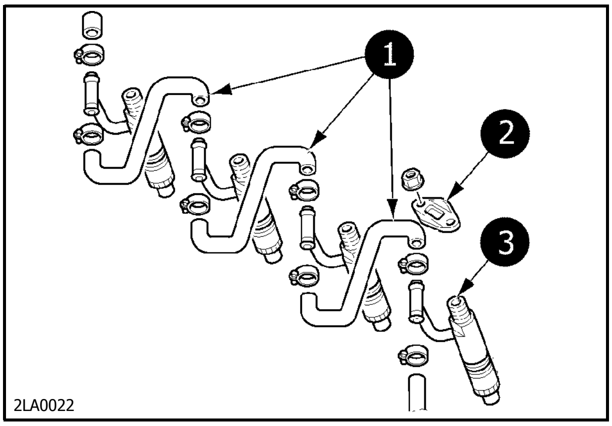
19

3. Shut off the fuel tank cock.
4. Remove the high pressure fuel hose (1).



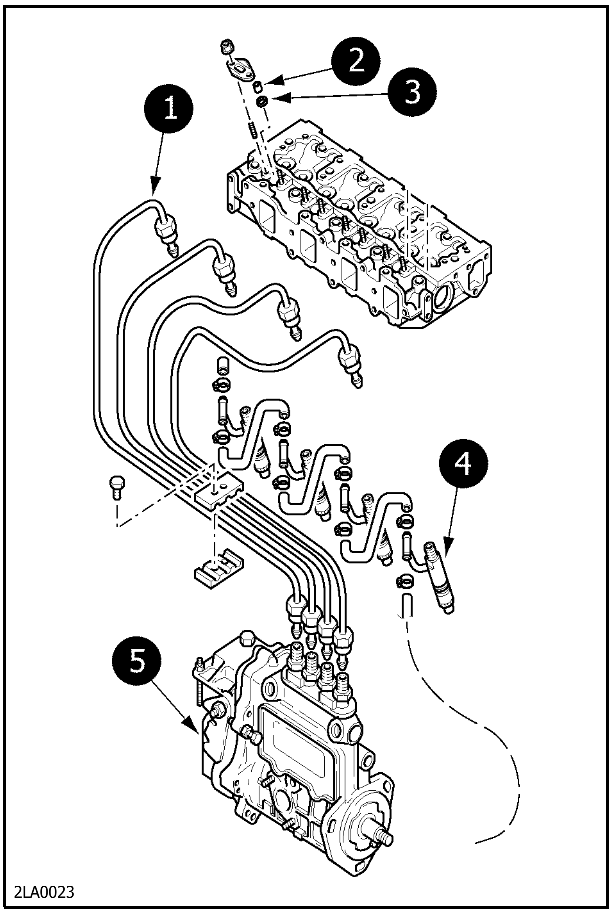
20

5. Remove the fuel return hose (1).
6. Slacken off the fastening nut on the injector (3) retainer (2) and remove both.



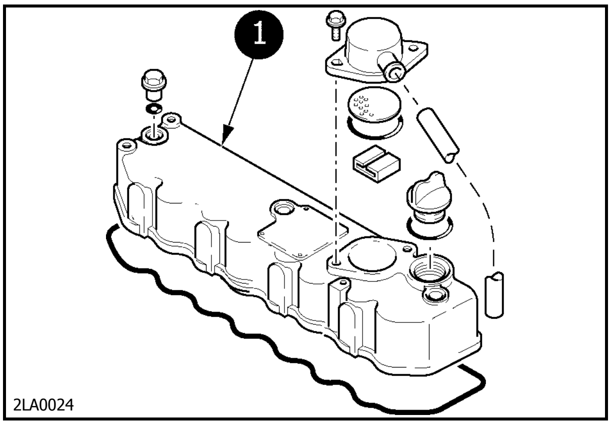
21

- If the injector housing (3) has remained on the cylinder head, detach this latter before removing the injector (3) housing.
- Seal the respective threads with tape or some other material to prevent dust from penetrating into the injector (4), injection pump (5) and high pressure hose (1).
- Replace the protective element (2) with a new one whenever the injector (4) is removed.



22

7. Remove the valve cover unit (1).

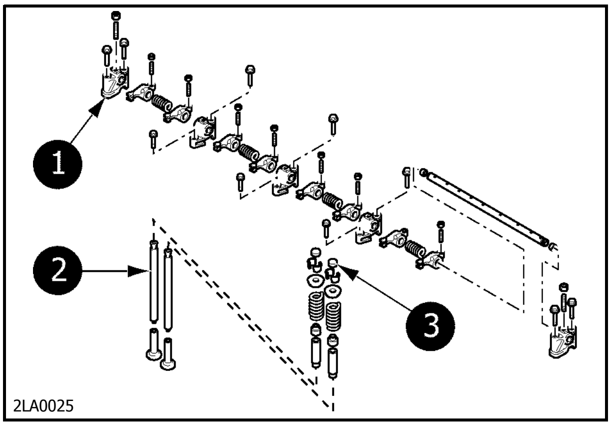


23

8. Remove the rocker arm/shaft assembly (1).
9. Remove the rocker arm rod (2).

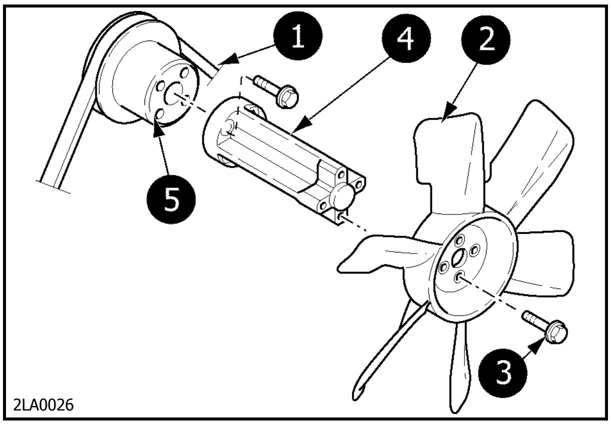
> Apply a label to the rocker arm rod (2) for each cylinder to ensure that the rods are remounted in the right order.

10. Remove the cap (3) of the valve from the head of the intake/exhaust valves.



24

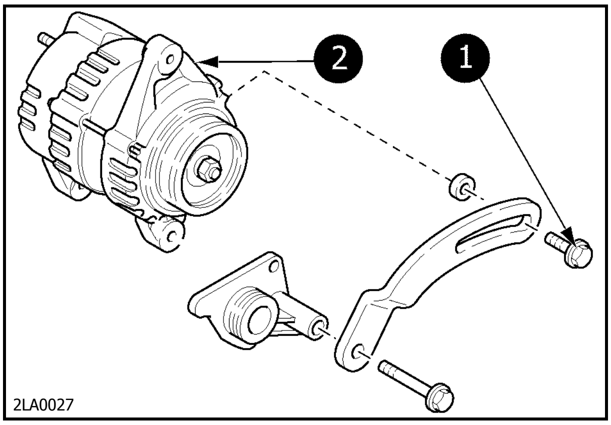
11. Unscrew the fixing bolts and remove the fan (2).
12. Slacken off the fixing bolt (1, fig. 26) from the adjuster bracket of the alternator belt, then detach the belt itself (1).



25

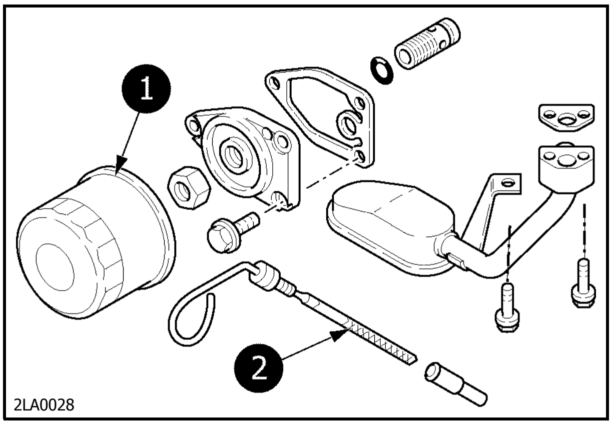
13. Remove the alternator (2).
14. Remove the spacer of the cooling fan (4, fig. 25) and the pulley (5, fig. 25).

> Do not force the alternator (2) towards the cylinder block as it could be damaged.



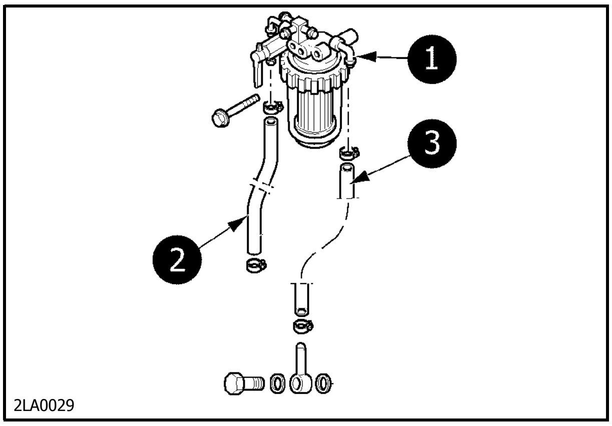
26

15. Remove the lubricating oil filter unit (1).
16. Take the oil level dipstick (2) from its hole.



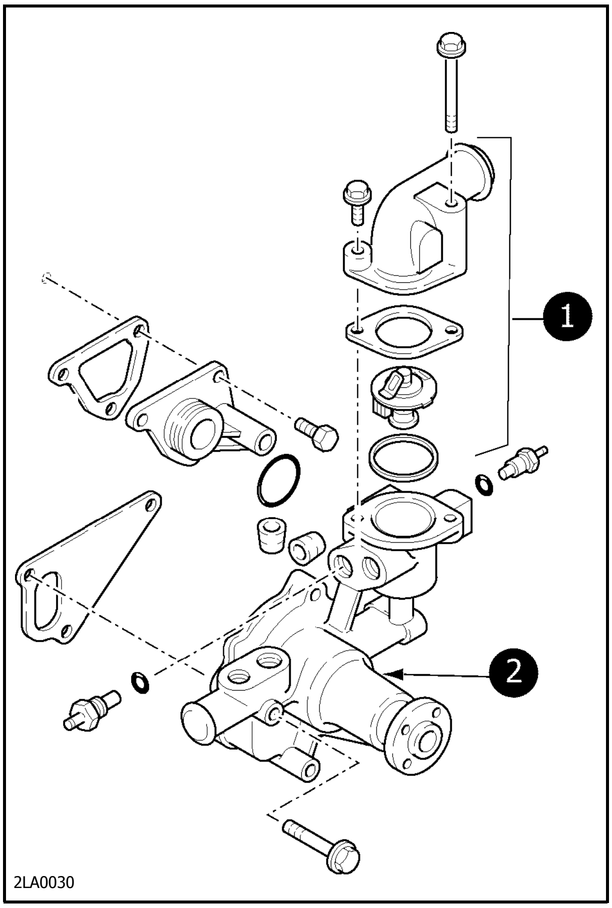
27

17. Remove the fuel return hose (2) and (3).
18. Remove the fuel filter (1).



28

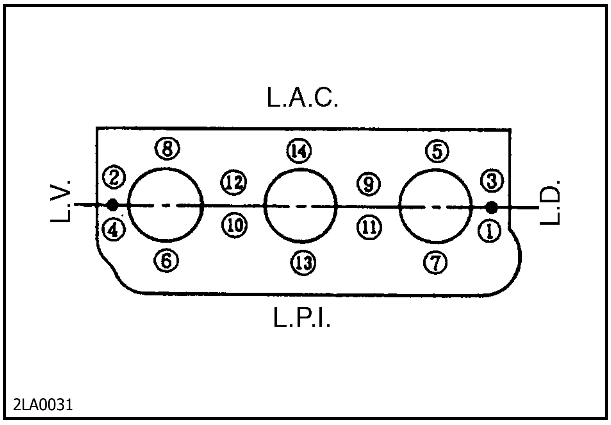
19. Remove the thermostat unit (1).
20. Remove the pump of the cooling system (2).



29

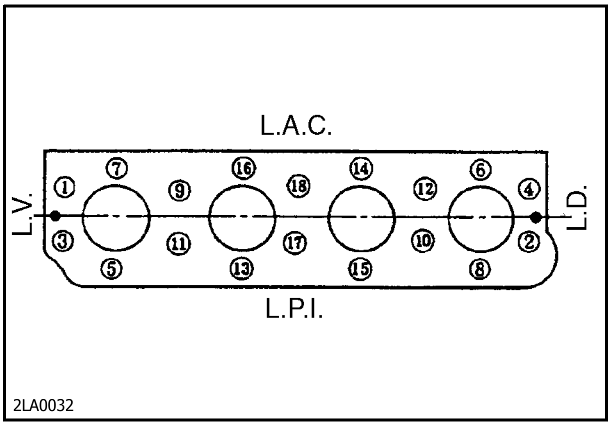
21. Unscrew the fixing bolts (1, fig. 32) from the cylinder head (2, fig. 32). Take particular care to prevent the components from being damaged and slacken off the bolts in the order indicated below:

- in the figure on the right (fig. 30) for the three-cylinder engine (Mod. MISTRAL AMERICA 40)



30

- in the figure on the right (fig. 31) for the four-cylinder engine (Mod. MISTRAL AMERICA 45/50).

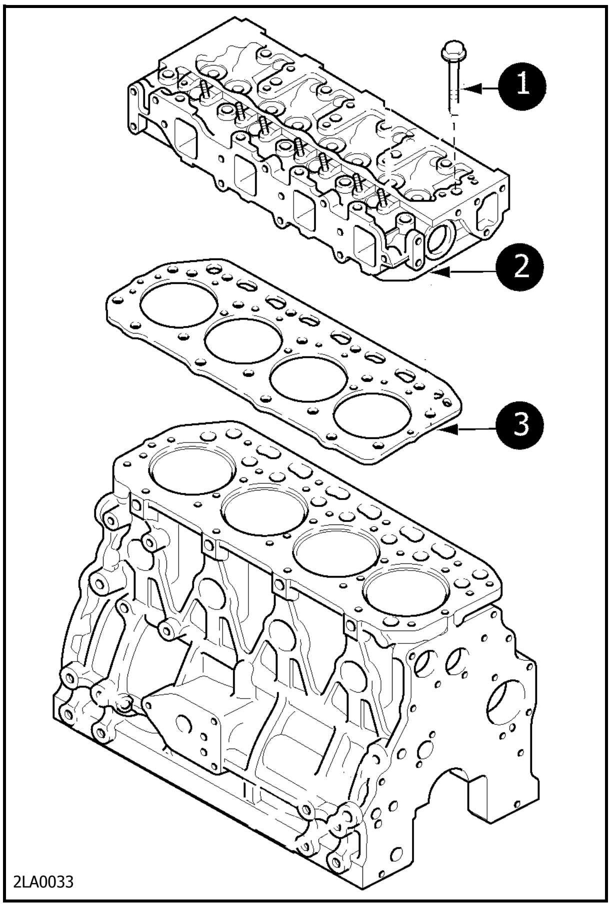


31

L.V. = Flywheel side
L.D. = Timing system side
L.A.C. = Camshaft side
L.P.I. = Injection pump side

22. Remove the cylinder head assembly (2).

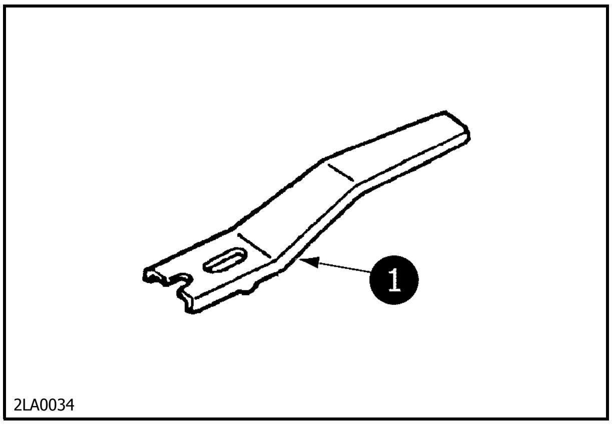
23. Remove the head gasket (3).



32

24. Remove the intake/exhaust valves from the cylinder head in the following way:

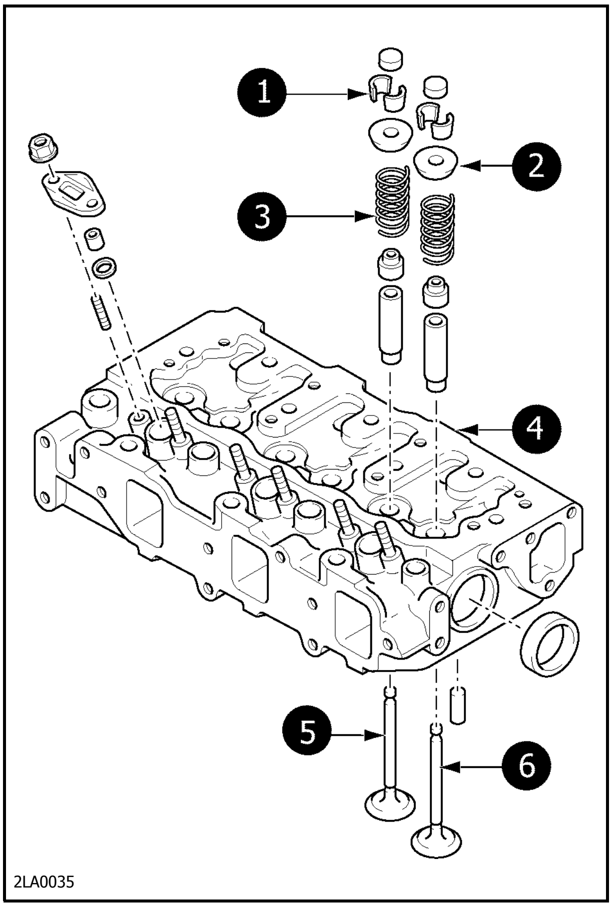
- Using a compression tool (1) **003 MT MIS**, compress the valve spring (3, fig. 34) and remove the cotters (1, fig. 34).



33

- Remove the valve retainer (2) and the spring (3).
- Remove the intake valve (6) and exhaust valve (5).

Repeat the sequence of operations for the remaining valves.

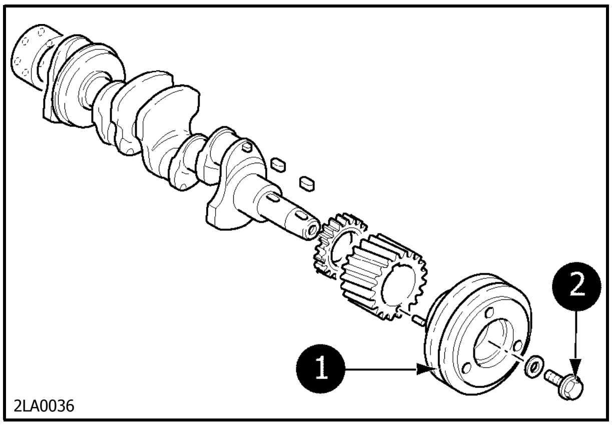


34

25. Remove the bolt (2) that connects the V-pulley of the drive shaft (1).

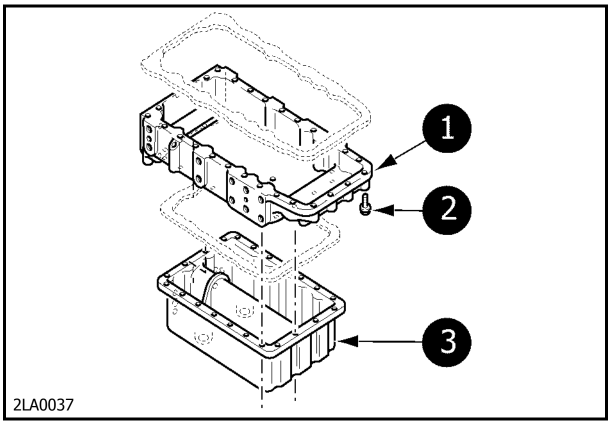
26. Use a puller to take out the drive shaft pulley (1).

> Tap on the bolt (2) with a plastic mallet or some similar tool in order to remove the pulley (1).



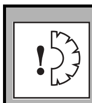
35

27. Remove the screws (2) that fix the spacer (1) between the crankcase and oil sump (3).



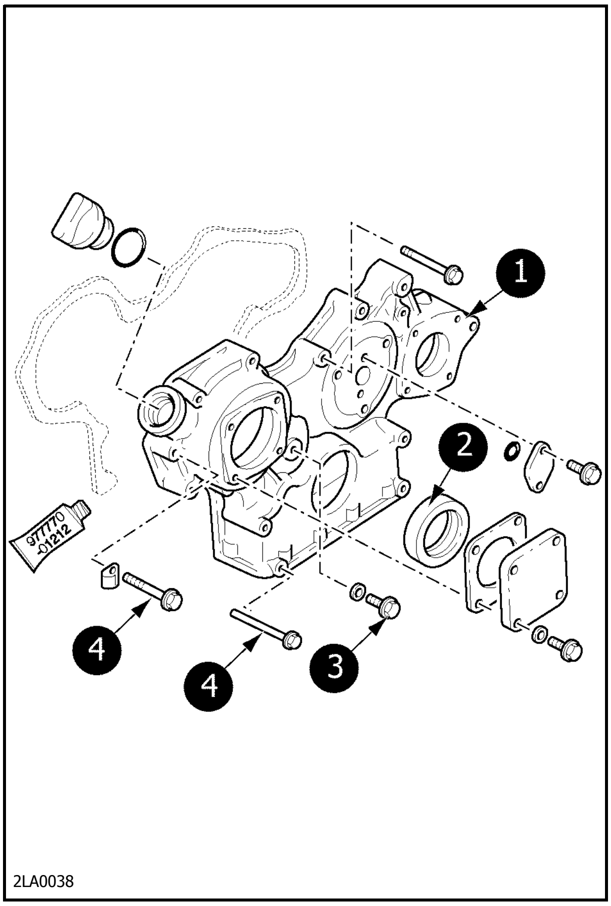
36

28. Unscrew the fixing bolts (4) from the gearbox (1).



Always remove the bolt from the reinforcing element (3) in the center of the gearbox.
When the gearbox is removed, remember to protect the retainer seal (2) in an adequate way to prevent it from being damaged.

29. Remove the gearbox (1).

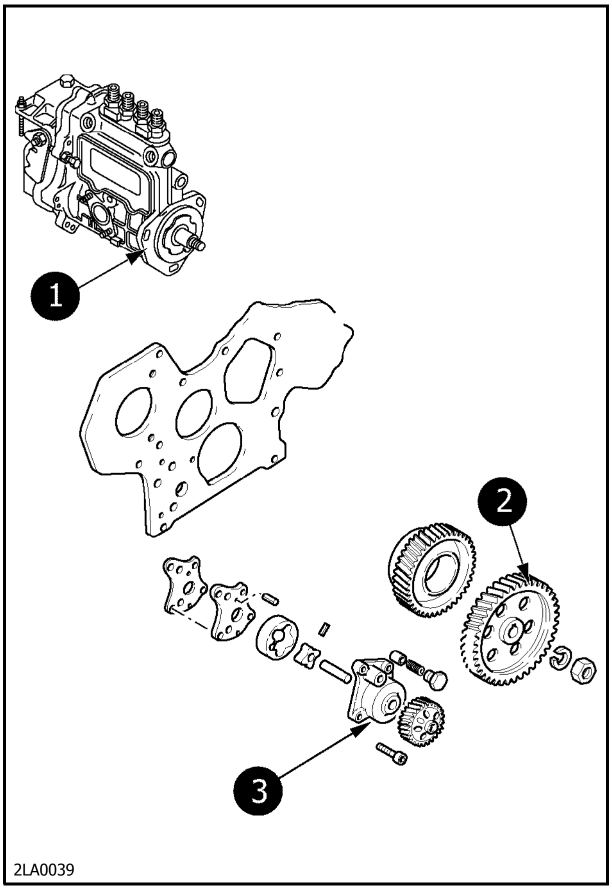


37

30. Remove the nut from the driven gear (2) of the injection pump (1). Take the gear out with an appropriate puller.

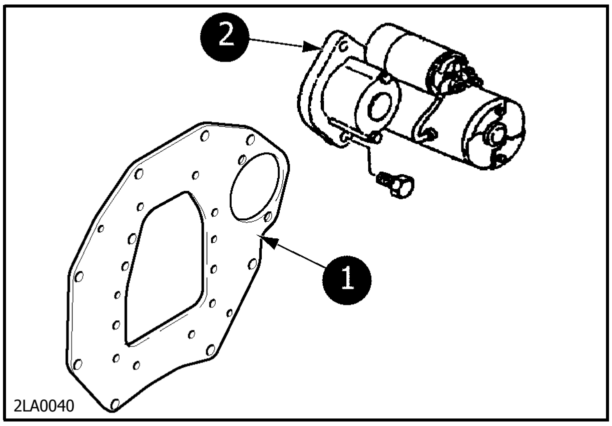
> Before the injection pump (1) is removed, check the position of the arrow on the body of the pump used to time the injection phase and the position of the line marked on the gearbox flange.

31. Remove the injection pump (1).
Remove the lubricating oil pump (3).



38

32. Remove the starter motor (2) from the gearbox flange (1).

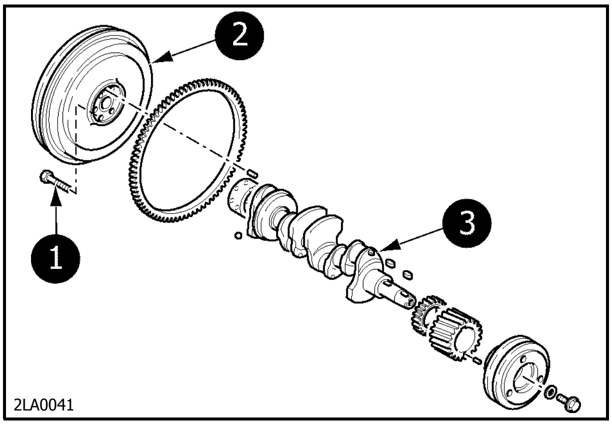


39

33. Remove the fixing bolts (1) from the flywheel on the drive shaft (3).

34. Remove the flywheel (2).

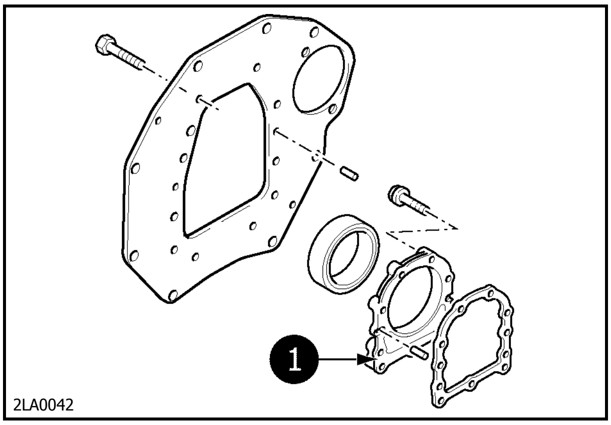
> Protect the ring gear in an adequate way to prevent it from being damaged.



40

35. Remove the retention seal box (1) by inserting a screwdriver into the grooves on both sides of the box itself.

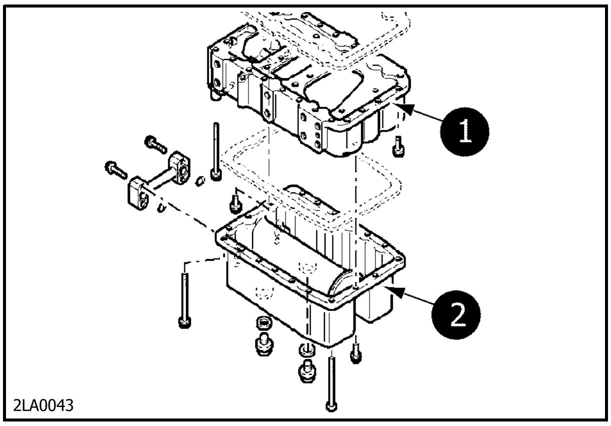
Take care to protect the seal to prevent it from being damaged.



41

36. Remove the spacer (1) and the oil sump (2).

Position the cylinder block assembly with the surface pointing downwards.
Take care to protect the combustion surface to prevent it from being damaged.



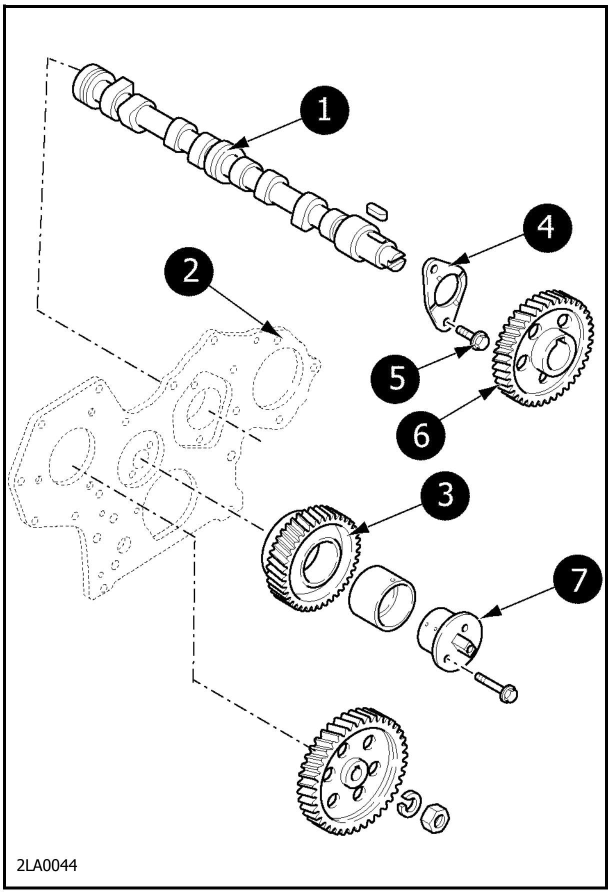
42

37. Remove the intermediate gear shaft (7), then remove the gear itself (3).

38. Remove the bolt (5) that fixes the thrust bearing (4) through the hole of the camshaft gear (6). Remove the camshaft assembly (1).

Move the cylinder block to one side to prevent the tappets (1, fig. 44) from jamming on the cam.
Heat the gear (5) and the camshaft assembly (1) to 180°C - 200°C (they are shrunk-on) before splitting them.

39. Remove the gearbox (2) flange.



43

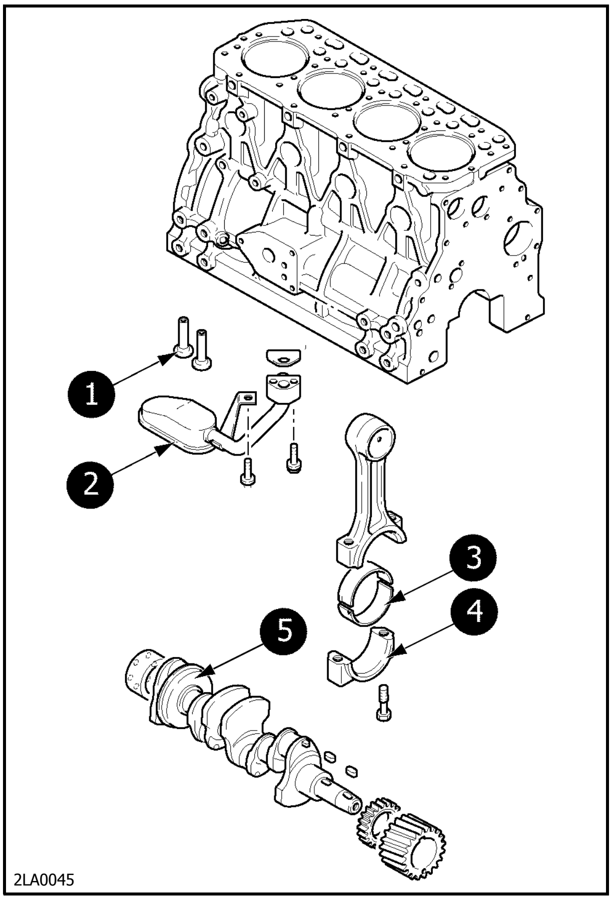
40. Remove the oil pump filter (2).

41. Remove the big end pin cap (4).

> Make sure that the number of the big end cap (2, fig. 45) matches the number of the cylinder.
> Make sure that the big end pin bearing (3) does not drop off when the cap (4) is removed.

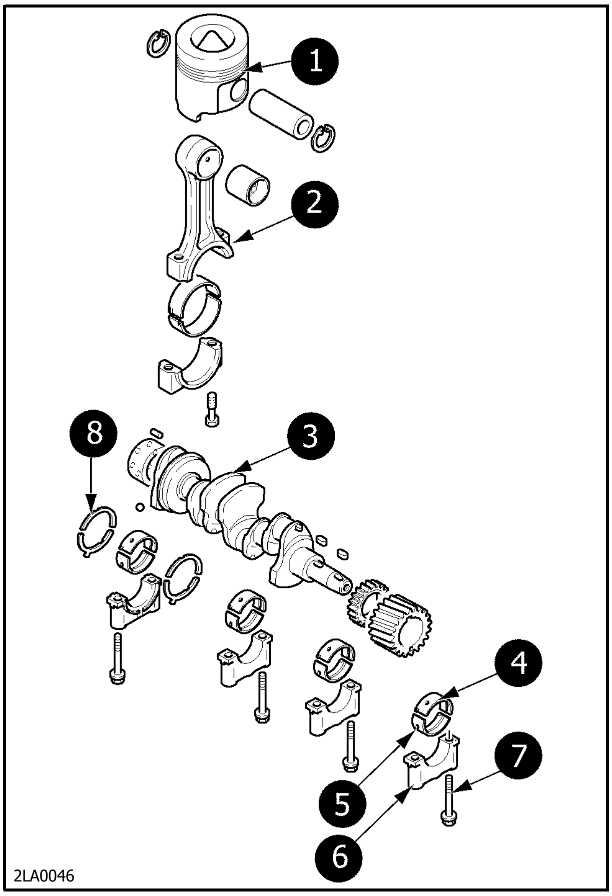
42. Remove the piston (1, fig. 45) and connecting rod (2, fig. 45) without having to take out the drive shaft. To do this, proceed in the following way:

- Turn the drive shaft (3) and move the piston to bottom dead center (B.D.C.).
- Remove the carbon deposits from the upper wall of the cylinder using fine grain glass paper. Take care to prevent the inner surfaces of the cylinder from being damaged.
- After having detached the cap of the big end pin (5), turn the drive shaft and bring the piston to bottom dead center (B.D.C.).
- Take out the piston/connecting rod assembly by lightly tapping on the big-end (2, fig. 45) with the handle of a plastic mallet.



44

43. Remove the bolt (7) from the main bearing support (6). Detach the cap (6) along with the lower half bearing (5) of the main bearing.



45

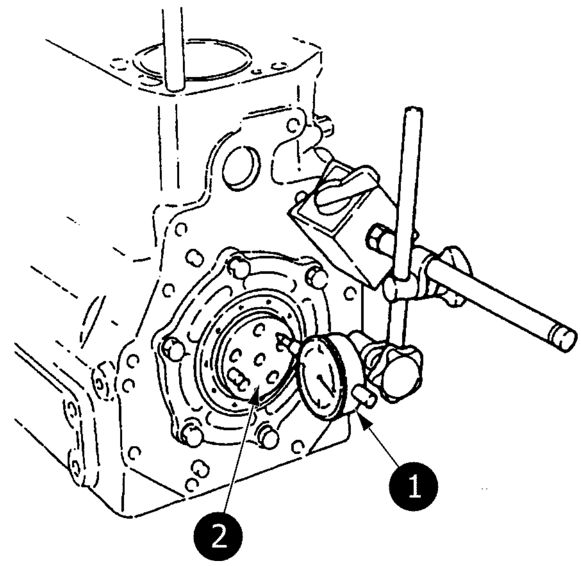
Before taking out the drive shaft, measure the float from this latter by placing a comparator (1, fig. 46) on its end (3). Now proceed as described in "Drive shaft inspections, measurements and repairs – Drive shaft float".

Alternatively, insert a thickness gauge straight between the bearing ring (8, fig. 45) and the thrusting surface on the drive shaft in order to measure the float, which must be 0.090 - 0.271 mm (for all models).

If the value measured is higher than the above limit, replace the bearing ring (8, fig. 45) as described below:

1. When the ring is removed (8, fig. 45), check and note down its position and mounting direction in relation to the cap.

2. Make sure that the groove in the bearing ring points outwards in relation to the cap.



46

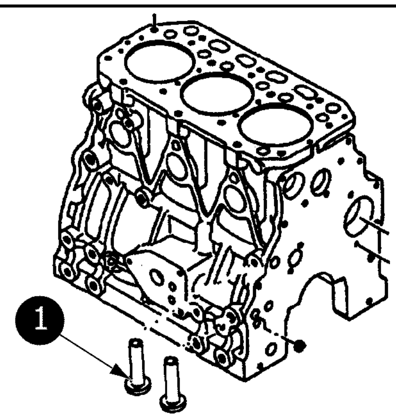
44. Take out the drive shaft (3, fig. 45), taking care to prevent it from being damaged.

45. Remove the upper half bearing (4, fig. 45) of the main bearing.

46. Remove the piston (1, fig. 45) and connecting rod (2, fig. 45) assembly if it is still mounted.

47. Remove the tappets (1, fig. 47).

> Apply a label to the tappets (1) for each cylinder to ensure that they are remounted in the right order.

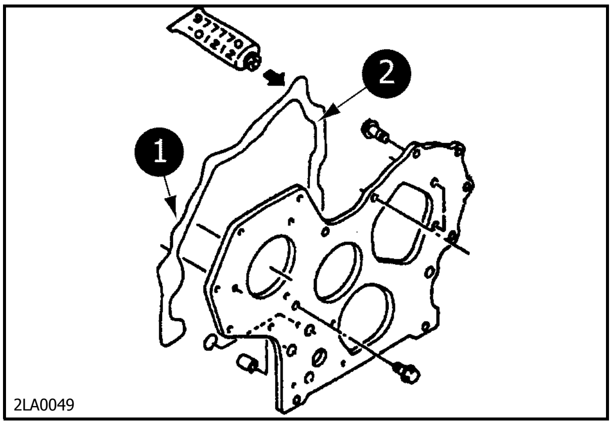


47

Bear in mind the following recommendations when remounting the engine:

> **DANGER**
> Do not use matches, cigarette lighters or torches as light source near the machine as it contains inflammable fluids.

- Thoroughly clean all parts if the engine must be demounted.
- Work through the engine demounting operations in reverse order when remounting the engine.
- The following descriptions illustrate assembly operations where greater attention is required in order to mount the parts in the correct way.
- The driving torques of the parts are given on page 17.
- Replace all the gaskets during the remounting phase when total or partial demounting operations are carried out.
- Lubricate the parts with engine oil before the rotating components and gaskets are fitted during the coupling phase.
- Liquid seals must be used for specific coupling surfaces when the parts are remounted:
  - Figure 48 - seal (1) between crankcase – gearbox flange (2).
  - Figure 49 - seal (1) between flange – gearbox cover (2).
  - Figure 50 - seal (1) on oil sump (2) contact surface.
- Lubricate the gasket with engine oil when the oil filter is remounted.



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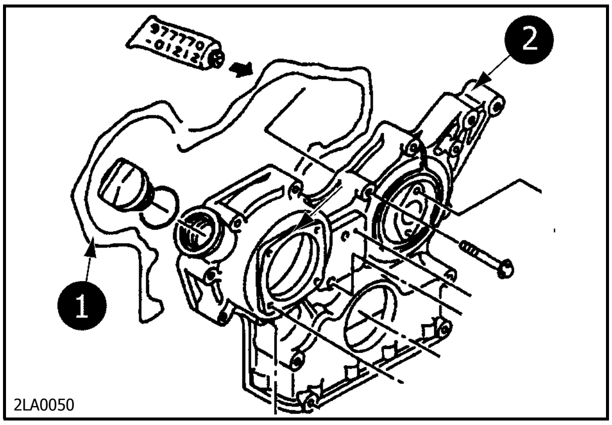
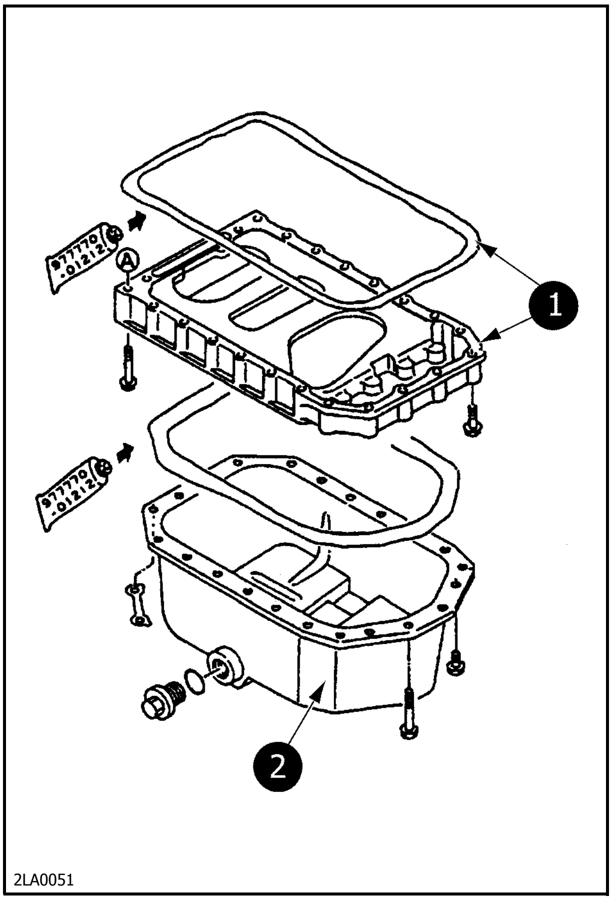


49

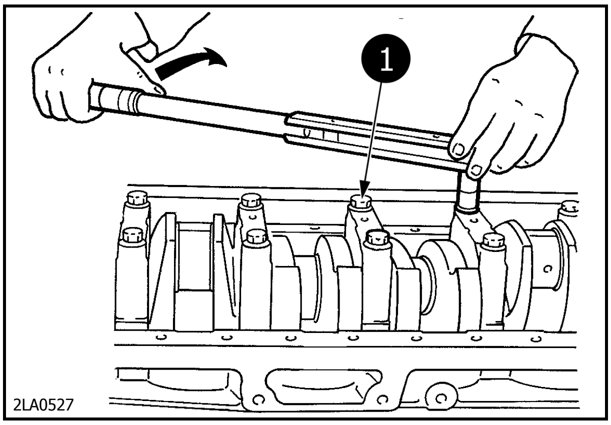


50

Assembly of tappets and drive shaft with main bearing caps, bearings and bearing rings

Proceed in the following way:

- Mount the tappets in their relative housings in the crankcase.
- Lubricate the housings in the crankcase with engine oil and position the main half bearings.
- Insert the lower drive shaft bearing half rings and apply grease to the shims of the second from last main bearing to facilitate the operation.
- Lubricate the upper part of the main half bearings with engine oil and mount the drive shaft, taking care to prevent the previously mounted bearing half rings from being damaged.
- Lubricate the main journals with engine oil. Position the main bearing caps along with the relative half bearings and mount the upper bearing half rings (on the second from last main bearing cap).
- Turn the drive shaft a few times in order to allow the various components to adapt.
- Mount the bolts (1) that fix the main bearing caps, bringing them into contact with the same, then tighten them to the prescribed torque value.
- After the drive shaft has more or less been mounted, check the float in compliance with the procedure described in "Drive shaft inspections, measurements and repairs – Drive shaft float".
- Apply liquid seal to prevent gaps from forming in the centre. Failure to do this could lead to oil leaks, etc... (see section 100).

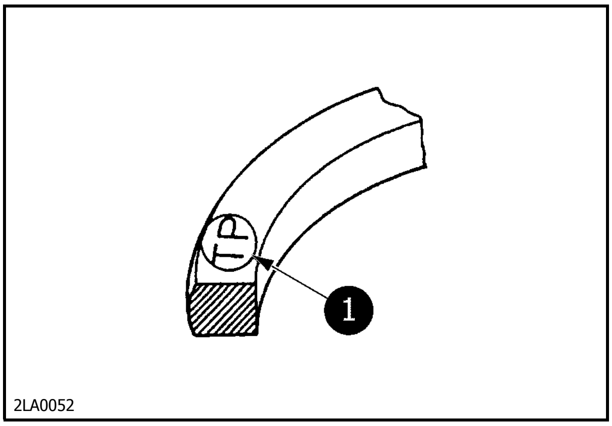


51

Assembly of pistons complete with piston rings, pins, connecting rods, caps and bearings

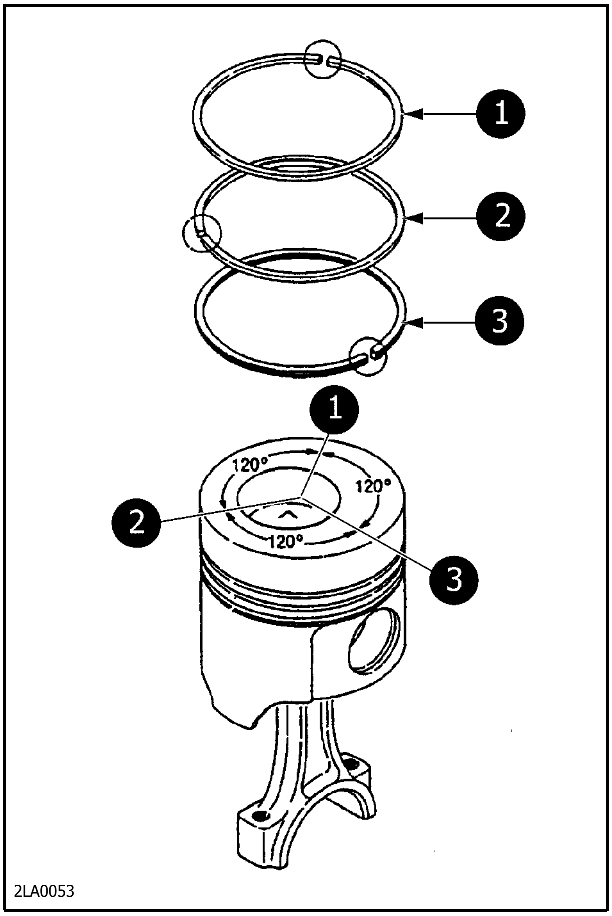
Proceed in the following way:

- Lubricate the pistons, piston rings and cylinder liners with engine oil before mounting them.
- Mount the piston rings on the piston housings with the manufacturer's mark (1) near the indentation, pointing upwards (combustion chamber) and using tool **004 MT MIS**.



52

- Make sure that the piston rings (1, 2 and 3) are free to move in their housings and that the indentations are staggered 120° in relation to each other.
- Mount the pistons complete with connecting rods into the crankcase. Make sure that the connecting rod matches the right cylinder.

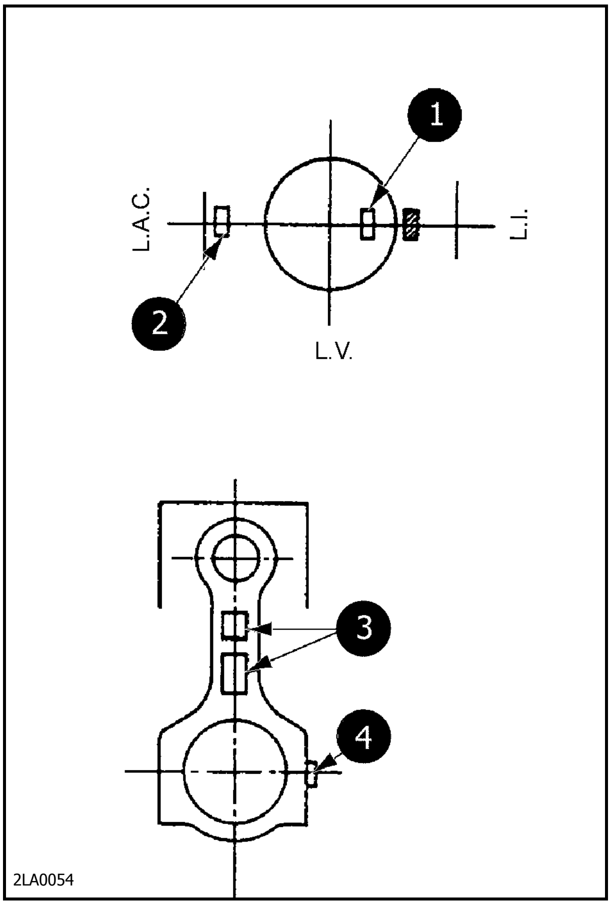


53

- Mount tool **005 MT MIS** in order to fit the pistons into the cylinder liners. Proceed with care to prevent the indentations described in the previous step from being staggered.

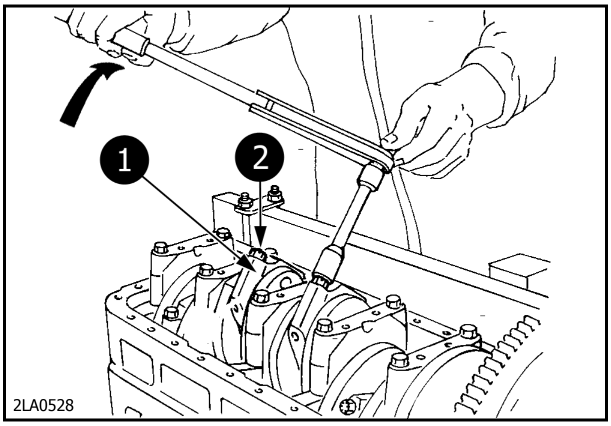
- Mount the pistons complete with connecting rods into the crankcase. Make sure that the connecting rods and cylinders match and that the positions of the connecting rods comply with the indications given by the marks on the connecting rods themselves.

Key:
1. D.I. mark.
2. Cylinder size indication
3. Stamped mark.
4. Alignment mark.
L.A.C. = Camshaft side
L.I. = Injector side
L.V. = Flywheel side



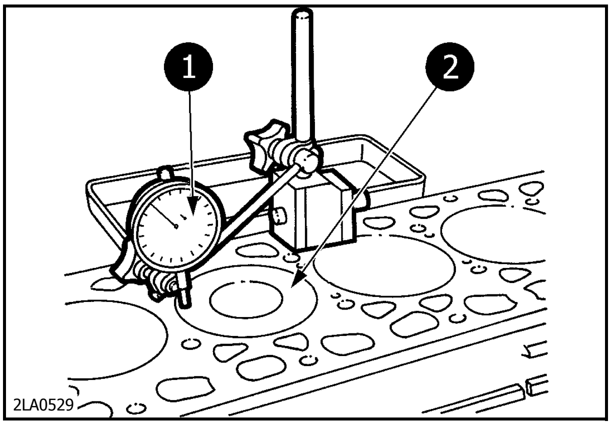
54

- Position the big end caps complete with their relative bearings, on the drive shaft and tighten the fixing bolts to a 44.1 – 54.0 Nm (4.5 – 5.0 kgm) torque value.



55

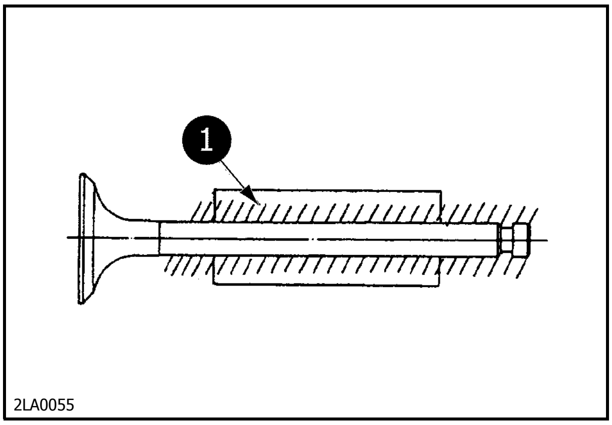
- Turn the rotating stand through 180° and clean the top surface of the crankcase.
Bring the pistons (2) to TDC (top dead center) and use a comparator with magnetic base (1) to check that the extent to which the top surface of the pistons projects in relation to the crankcase does not exceed the prescribed tolerance value.



56

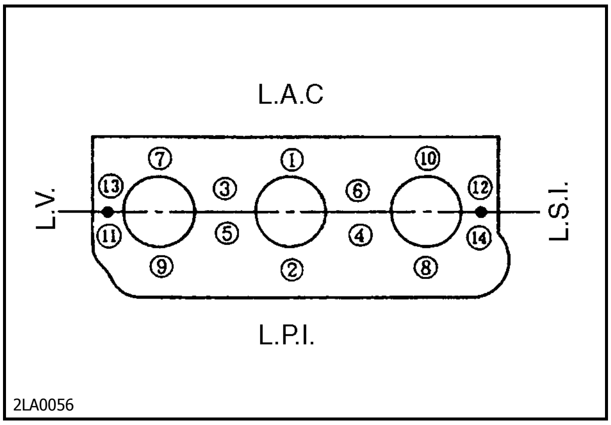
Assembly of timing, lubrication, starting, recharging, cooling and fuelling components

- Remove the gearbox flange.
- Shrink-on the camshaft gear to the shaft itself.
- Fit the camshaft assembly back into the crankcase and fix the relative crankcase thrust bearing with the bolts.
- Fit the intermediate gear back on the relative shaft.
- Fit the intermediate gear back shaft into the crankcase.
- Fix the spacer between the crankcase and oil sump, to the crankcase itself, then fix the sump to the spacer and tighten the relative bolt.
- Remount the drive shaft gasket box.
- Fit the flywheel back on to the drive shaft and tighten the fixing bolts to a 83.4 – 88.3 Nm (8.5 - 9 kgm) torque value.
- Fit the starter motor back on to the gearbox flange.
- Remount the lubricating oil pump.
- Mount the driving gear of the injection pump back on to the pump itself.
- Remount the injection pump and proceed with the timing operation.
- Mount the gearbox back on to the crankcase with the flange in between.
- Remount the screws that fix the spacer (crankcase-oil sump) to the gearbox.
- Fit the V-pulley back on to the drive shaft and fix it in place by tightening the relative bolt to a 112.8 – 122.6 Nm (11.5 – 12.5 kgm) torque value.
- After the gears have been mounted, check to make sure that the gear train has been correctly timed as indicated in "Gear Inspections, Measurements and Repairs – Gear Train".
- Apply lubricating oil through to the lower surface (dotted part in the figure) of the valve guide (1) before inserting the valve stem.
- Fit the springs and cotters back into the cylinder head and valves (intake and exhaust).



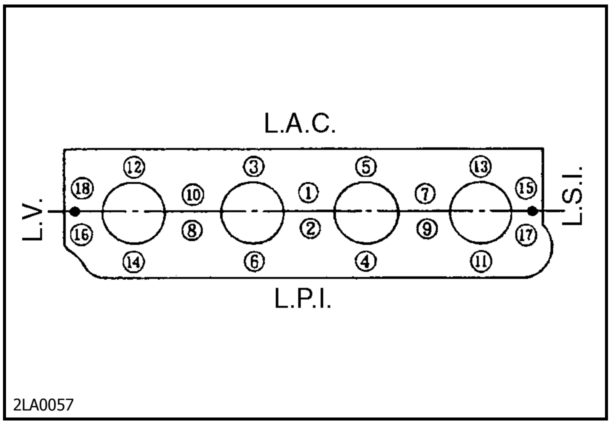
57

- Proceed by mounting (and correctly positioning) the cylinder head, thoroughly cleaning and eliminating the grease from the top part of the crankcase.
- Fit the cylinder head assembly and tighten the fixing bolts to a 85.3 – 91.2 Nm (8.7 – 9.3 kgm) torque value in the indicated sequence:
  - in the figure on the right (58) for the three-cylinder engine (mod. MISTRAL AMERICA 40)



58

  - in the figure on the right (59) for the four-cylinder engine (mods. MISTRAL AMERICA 45/50).



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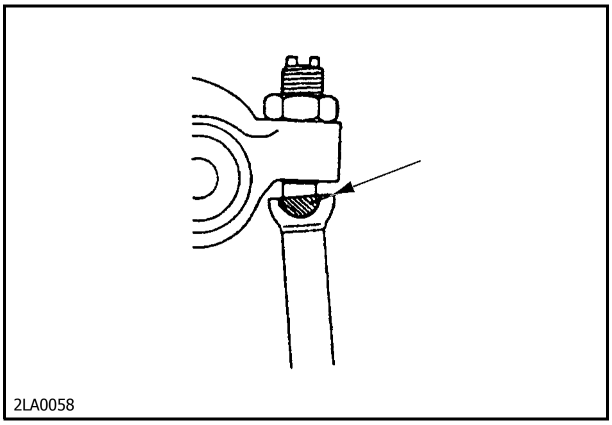
Key:
L.A.C. = Camshaft side
L.S.I. = Gearbox side
L.P.I. = Injection pump side
L.V. = Flywheel side

- Remount the pump of the cooling system and the thermostat unit.
- Re-connect the coolant delivery hose to the pump.
- Remount the fuel filter.
- Remount the fuel return hoses.
- Fit the dipstick back in place.
- Remount the lubricating oil assembly.
- Remount the spacer of the cooling fan and the V-pulley.
- Remount the alternator.
- Remount the cooling fan-alternator belt, then remount the fan. Consult "Belt tension inspection" to establish the correct belt tension.

- Remount the rocker arm rods in compliance with the rods-cylinders matches defined by labelling during the demounting phase and by first applying a film of lubricating oil in the hatched part of the rocker arm rod as shown in the figure.
- Remount the rocker arm/shaft assembly.
- Remount the injector retainers and lock them to the injectors with the retainer nuts (also replace their protection elements).
- Remount the fuel return hose.
- Remount the high pressure fuel hose.



60

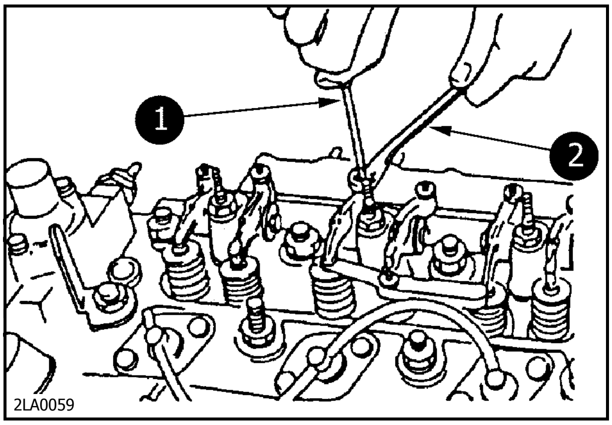
- Re-open the fuel tank cock.
- Remount the intake manifold.
- Remount the exhaust manifold.
- Top up the level of the lubricating oil and coolant.

After the engine has been completely remounted and the fluid levels topped up, proceed with the adjustments and inspections described in the following sections:

- “Valve play adjustment”,
- “Checking the cooling circuit and radiator for leaks”,
- “Idling rate adjustment (minimum and maximum)”

Valve play adjustment

1. Check the valve play when the engine is cold.
2. Move the piston to top dead center (TDC) in the cylinder where the measurements are being taken.
3. Using a spanner (2), slacken off the lock nut and then the adjuster screw, using a screw-driver (1). Make sure that the valve cap is correctly positioned and free from dirt deposits.

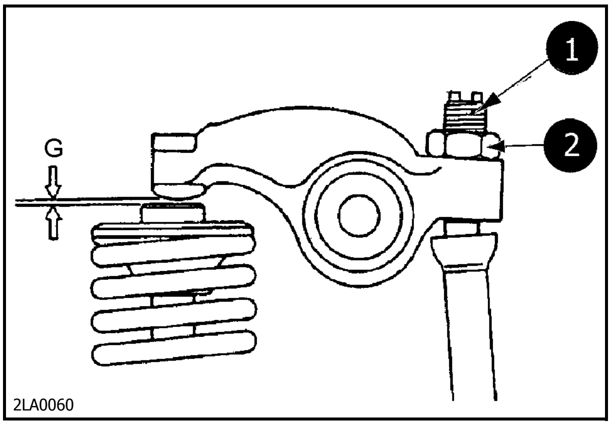


61

4. Insert a thickness gauge with a play value (G) of:

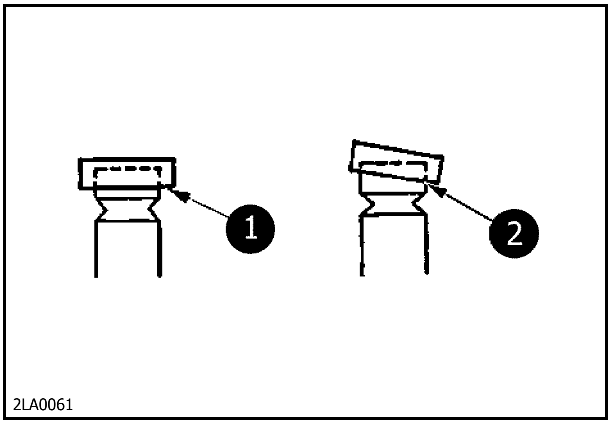
   0.15 - 0.25 mm

   between the rocker arm and cap of the intake/exhaust valve.
   Tighten the adjuster screw (1) until the rocker arm pad touches the thickness gauge and fix with the lock nut (2).



62

- Replace the valve cap (1) if it is worn or damaged.
- Make sure that the cap is correctly positioned on the top of the intake/exhaust valves.



63

Key:

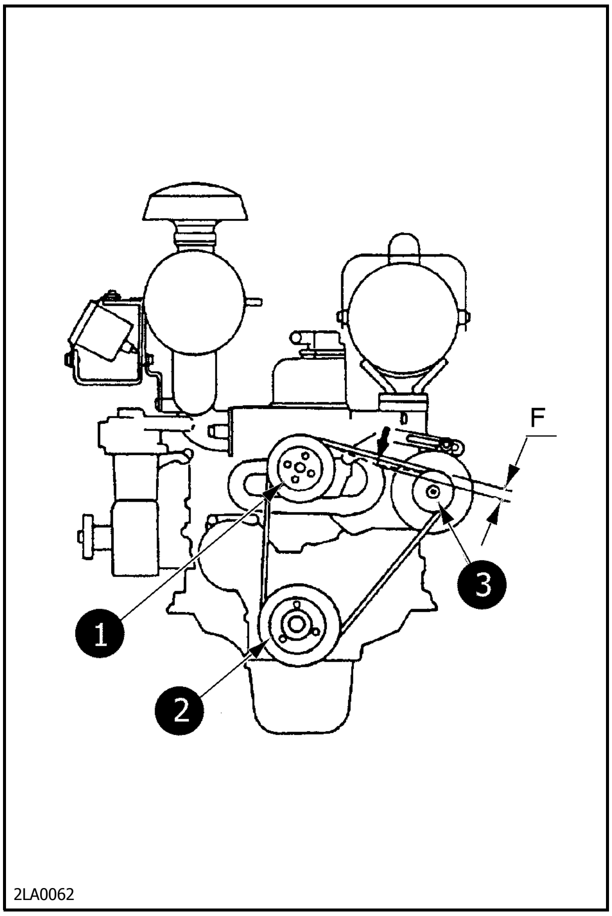
1. Normal position
2. Wrong position

How to check the belt tension

1. Press with the hand in the middle of the belt between the alternator (3) and the cooling pump (1) in the direction shown by the arrow. If the belt gives (F):

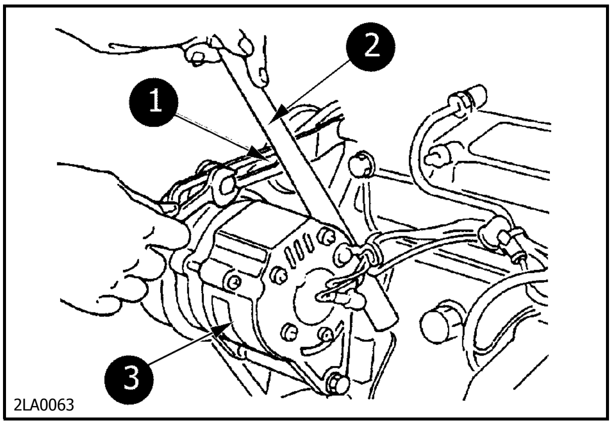
F = 10 - 15 mm

the belt tension is correct.



64

2. If the belt fails to give to the prescribed values, adjust the tension by changing the position of the alternator (3) by means of the adjuster bracket (1) and bar (2).



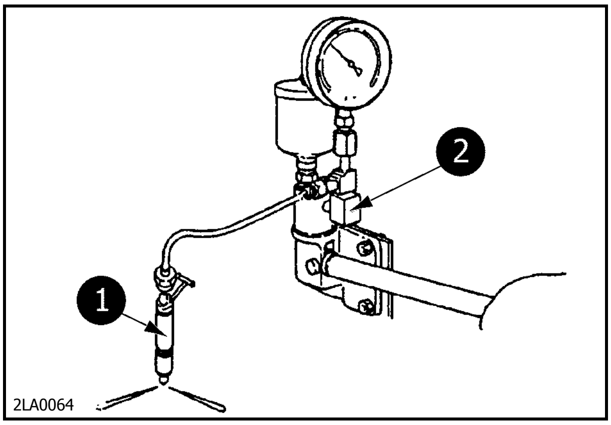
65

INJECTOR NOZZLE AND INJECTION PRESSURE MEASURING AND MONITORING

Injection pressure measurement

> ☞ Carefully remove the carbon deposits from the injector before proceeding with the inspections.

1. Connect the injector (1) to the high pressure hose of the injector test instrument (2).
2. Slowly operate the lever of the instrument (2) and note down the value indicated by the pressure gauge when the injector (1) starts to spray.



66

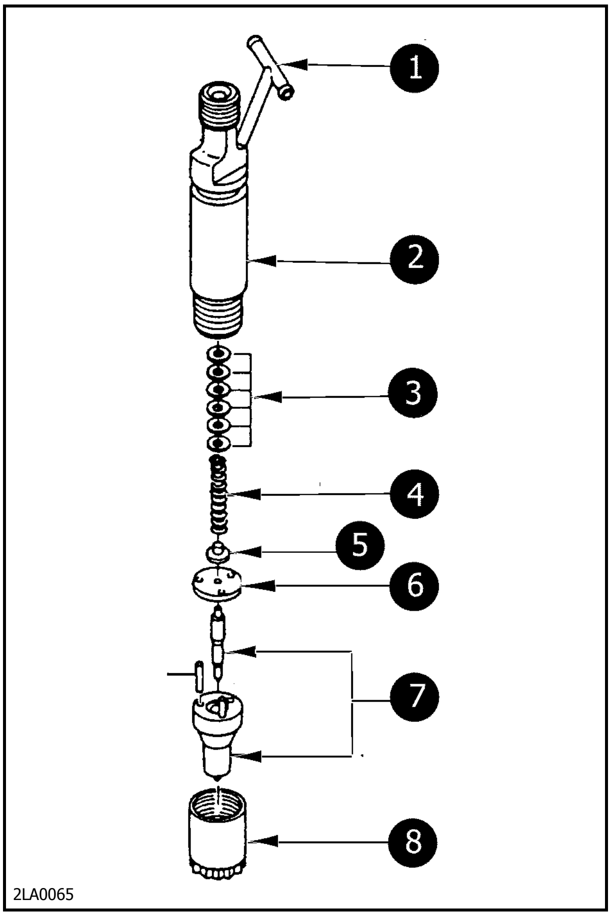
> ☞ Consult the table on page 8 for the injection pressure values of each engine.

3. If the pressure measured is less than the prescribed value, replace the adjuster ring of the injector with a thicker one calculated according to the indications given in the table below:

Thickness of the adjuster ring (mm)	Injection pressure adjustment
0.13; 0.15; 0.18; 0.4; 0.5; 0.8	Increase the thickness of the adjuster ring by 0.1 mm to increase the injection pressure by about 19 bar

View of the injector parts:

1. Fuel return hose coupling.
2. Injector body.
3. Adjuster ring
4. Spring
5. Spring housing
6. Atomizer retaining spacer.
7. Atomizer
8. Atomizer housing

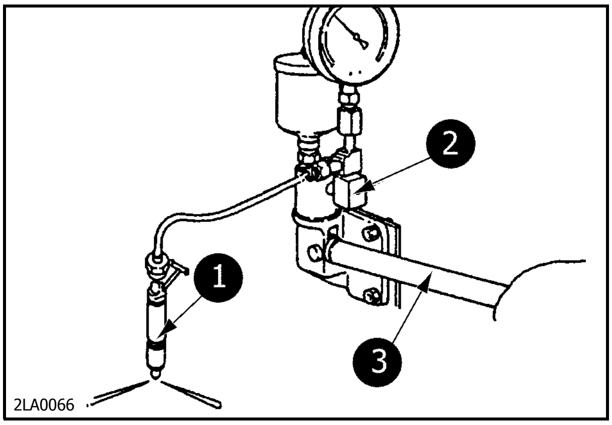


67

Jet inspection

Operate the lever (3) of the injector test instrument (2) 4 - 6 times, depending on the prescribed injection pressure (See page 8) while checking the jets.

- Make sure that the jet is neither a continuous nor fragmentary flow. Clean or replace the atomizer (7, fig. 67) if this is the case.
- Make sure that the jet of fuel around the median line of the injector is tapered in shape and that the delivery angle is about 150°. Clean or replace the atomizer if this is not the case.



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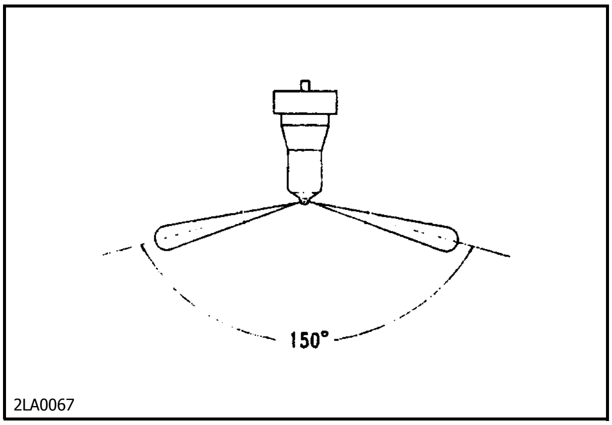
Refer to the figure on the right in order to define the shape of the jet:

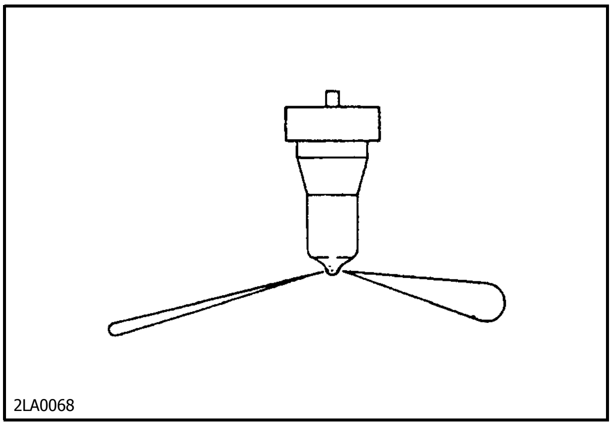
- normal jet see fig. 69;
- abnormal jet see fig. 70;

- Place a sheet of white paper 30 cm under the atomizer and make sure that the jet forms a perfect circle.
- After injection, make sure that no fuel drips from the injector.
- Make sure that there are no fuel leaks from the injection hole if the pressure is slightly lower than the prescribed value.



69

- Check the injector with the relative measuring instrument. Tighten and repeat the test if there is an excessive fuel return from the recovery joint. Replace the entire atomizer unit if the leaks persist.

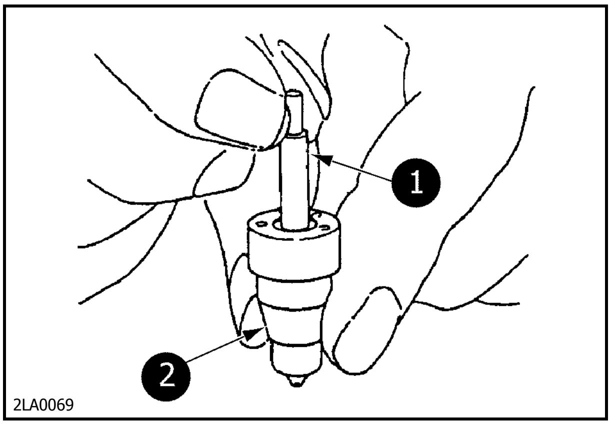


70

Atomizer valve sliding test

1. Thoroughly clean the atomizer valve (1) with clean diesel fuel.
2. Keep the body (2) of the atomizer in a vertical position and lift the valve about 1/3rd of its length.
3. Make sure that the valve drops back easily by itself when released. In this case, the valve is in a perfect condition.

> If the atomizer is new, remove the adhesive film and immerse it in clean diesel fuel (or another similar product) to clean the internal surfaces and remove all traces of rust inhibitor before it is used. New atomizers are spread with rust inhibitor oil and are covered with adhesive film to protect them from the air.



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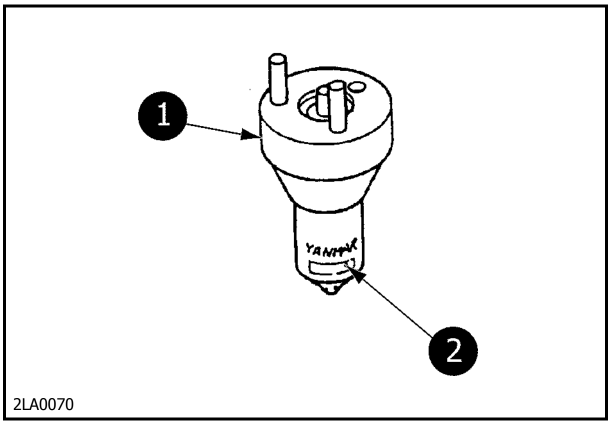
Identification number of the atomizer casing

Consult the following explanation to interpret the identification number (2) of the atomizer casing (1):

Y DLL A - 150 P 244JO

Model code
Dimensions: dimension F
dimension S
Injection angle
Atomizer positioning angle
Code A: angled
No code: not angled
Type: DLL (semi-long type)
YANMAR



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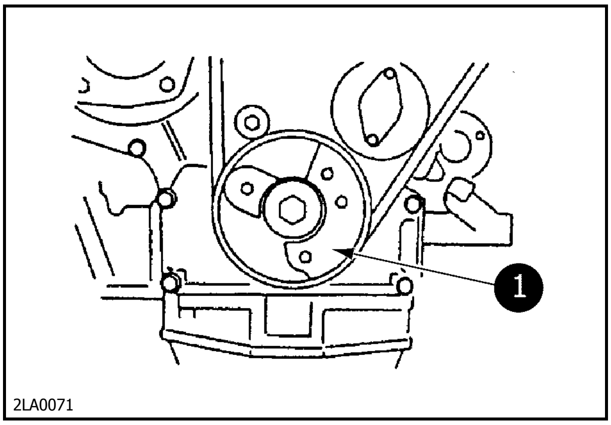
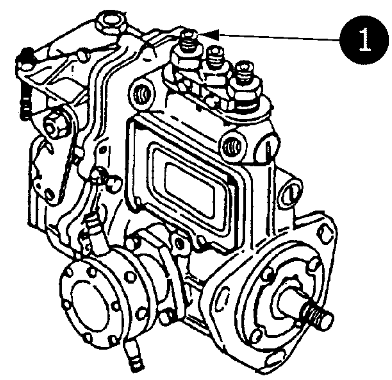
INJECTION TIMING ADJUSTMENT AND MONITORING

1. Use the pulley (1) of the drive shaft and turn the engine in the indicated direction.



73

2. Check the injection timing on the delivery valve of the injection pump for cylinder N° 1 (1). (Cylinder numbering is sequential beginning with cylinder N° 1 from the flywheel side).



2LA0072

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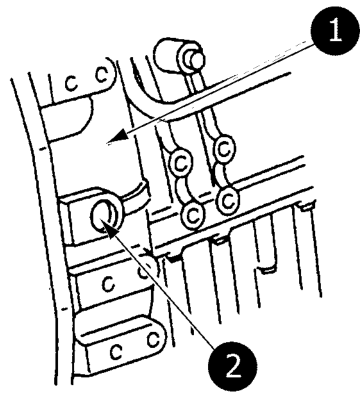
3. Turn the drive shaft in the indicated direction until the diesel fuel level reaches the upper limit of the spring casing of the delivery valve.



2LA0073

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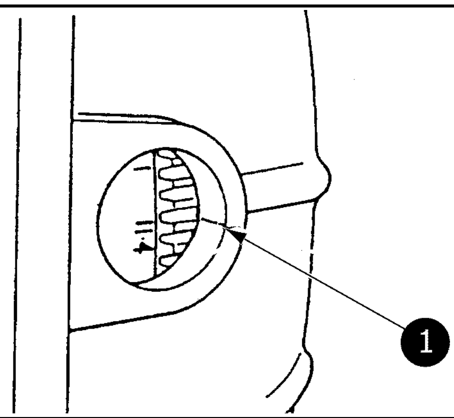
4. Find the timing notch on the flywheel (1) through the access hole (2).

> Consult page 8 for instructions about how to time the injection phase of each engine model.



2LA0074

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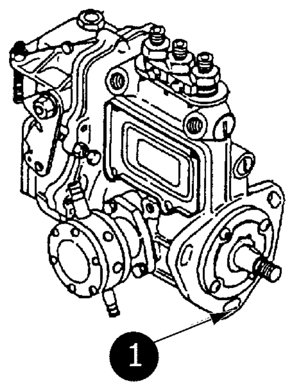
5. If the timing values differ from those prescribed, adjust by turning the injection pump towards the engine or in the opposite direction after having slackened off the lock nut (1) on it.

- Move the injection pump away from the engine if injection is delayed.
- Move the injection pump nearer to the engine if injection is in advance.



2LA0075

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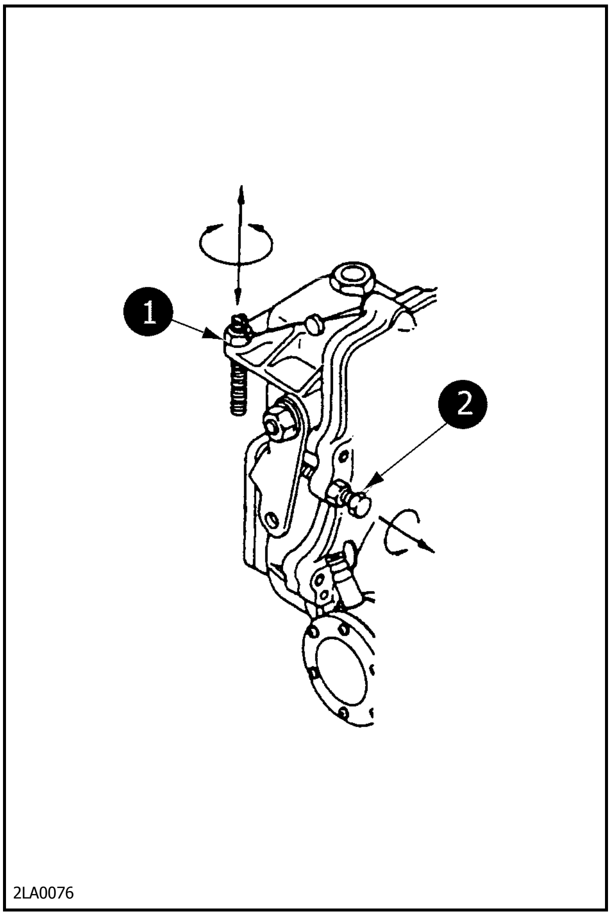
IDLING RATE ADJUSTMENT (MINIMUM AND MAXIMUM)

1. Allow the engine to warm up then gradually accelerate to top rate (see pages 3, 4 and 5).
2. If the top idling rate differs from the prescribed value, adjust by means of the maximum idling rate adjuster screw (1).
3. Allow the engine to idle (see pages 2, 3 and 4) by turning the minimum idling rate adjuster screw (2).



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HOW TO CHECK THE COOLING SYSTEM AND RADIATOR TO FIND LEAKS

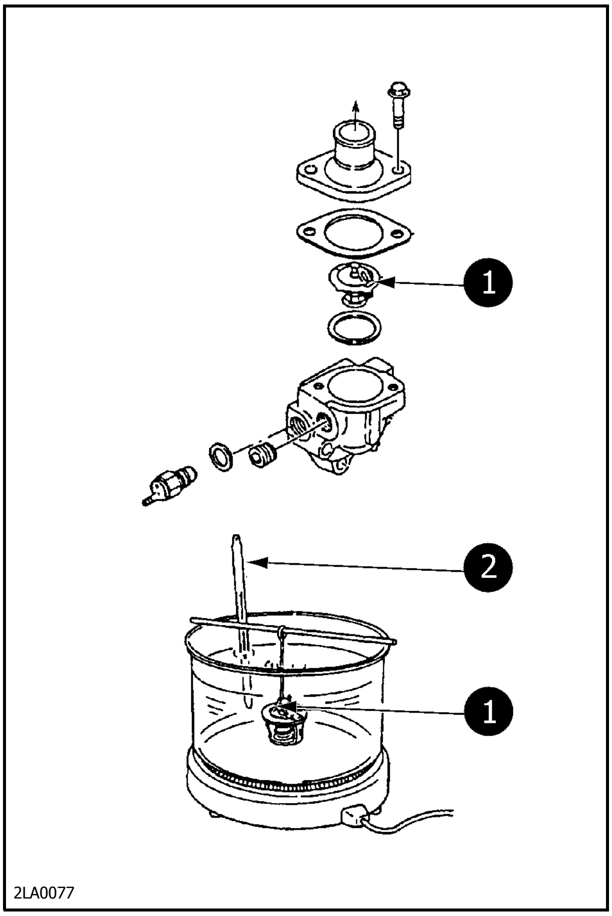
> The cooling circuit can only be efficiently checked when the engine is hot.

1. Make sure that the coolant in the radiator is at the right level.
2. Start the cooling pump and make sure that there are no leaks.

SENSOR INSPECTION

Thermostat

1. Immerse the thermostat (1) into a vessel full of water and heat this latter while measuring the temperature.
2. Make sure that the thermostat operates at the temperature of 69.5 - 72.5°C, measured with a thermometer (2). Failing this, replace it as it is defective.



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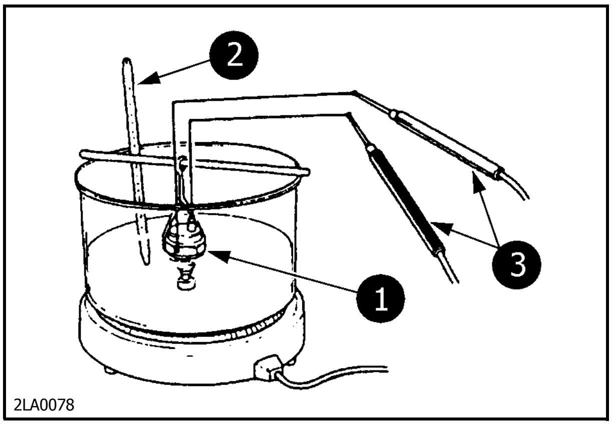
Thermal switch

1. Immerse the thermal switch (1) into a vessel containing antifreeze or oil.
2. Heat the liquid and measure its temperature with a thermometer (2).
3. If the tester connected to the prods (2) gives continuity values at the temperature of 107 - 113°C, then the thermal switch is operating correctly. Failing this, replace it as it is defective.



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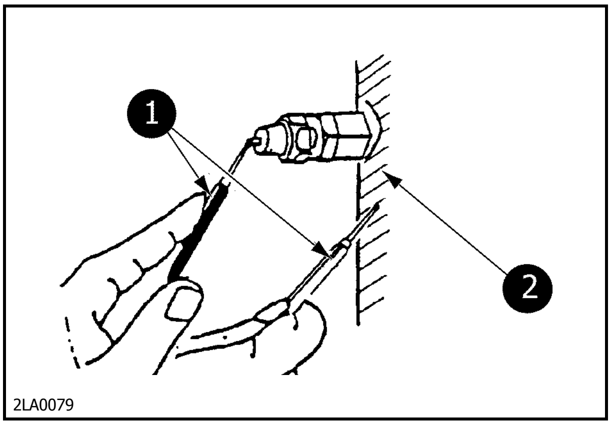
Hydraulic switch

1. Remove the connector from the hydraulic switch.
2. Start the engine and move the tester probes (1) near to the switch terminal and cylinder block (2).
3. If the tester gives a no-break indication, this means that the hydraulic switch is defective and must therefore be replaced.



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CYLINDER HEAD INSPECTIONS, MEASUREMENTS AND REPAIRS

Thoroughly clean the parts before proceeding with the inspections.

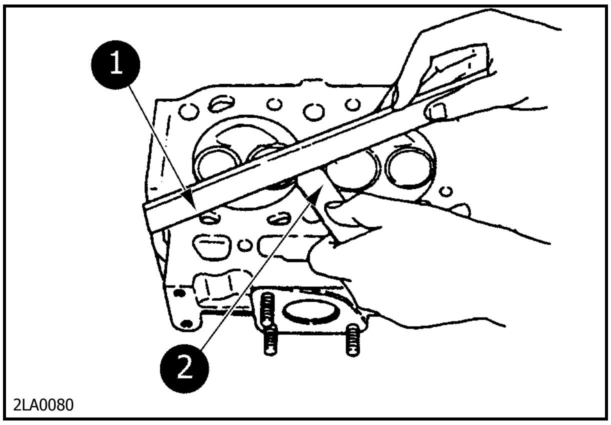
Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Warping and inspection of the combustion surfaces

1. Remove the intake/exhaust valves and the injector from the cylinder head. Clean the surface of the cylinder head.
2. Place a straightedge (1) along each of the four sides and on each diagonal of the cylinder head. Measure the play between the straightedge and the combustion surface with a thickness gauge (2).
3. Compare the result with the reference value which, in the specific case of a warped cylinder head combustion surface, is:

   for the normal dimension $\leq$ 0.05 mm

   for the limit (of wear) dimension= 0.15 mm
4. Check to make sure that the combustion surface is not discoloured, broken or cracked.



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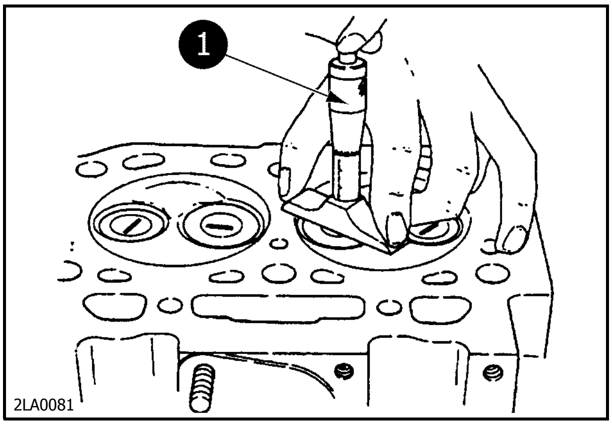
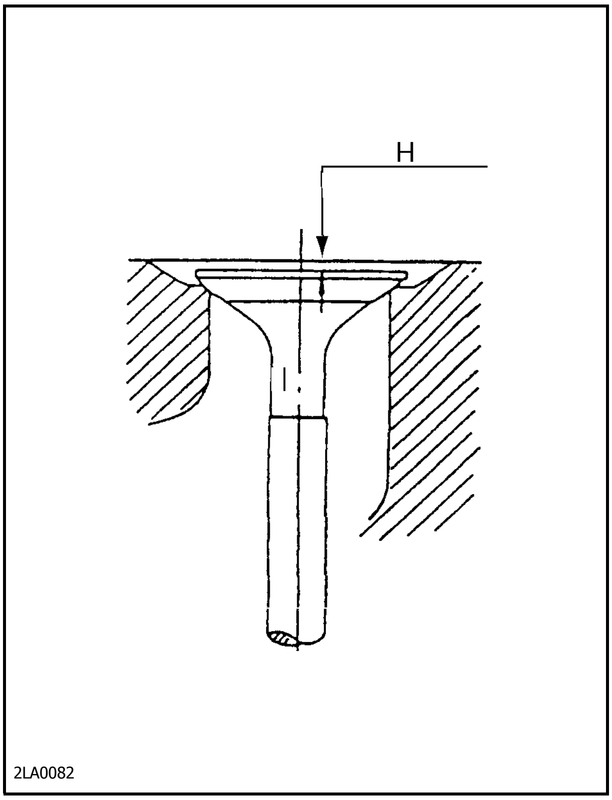
Valve impression

1. Lengthy use and repeated lapping can lead to a drop in combustion efficiency. Measure the depth (H, fig. 84) of the valve impression with a depth micrometer. Replace the valve if the impression is deeper than normal.



83

Standard values, for dimension (H), to compare with the measured values, are given in the table on page 10. 10.



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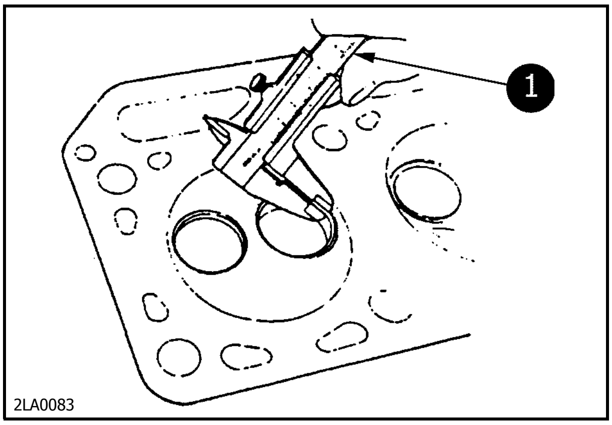
Valve housing width and angle

1. Remove the carbon deposits from the surface of the valve housing.
2. Measure the width and angle of the housing using a slide (1) and angle gauge.
3. Compare the obtained results with the standard values given on page 10.



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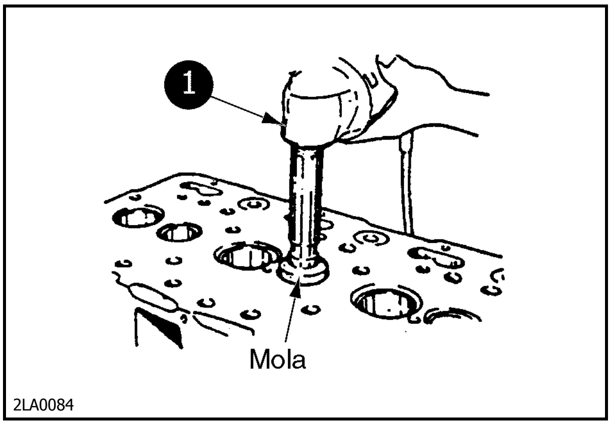
Valve housing intervention procedure

1. When the surface of the valve housing appears to be slightly worn or rough, lap with a valve compound mixed with oil to obtain a smooth mixture.
2. When the valve housing is very worn or rough, the defect can be corrected with a grinder tool (1) or valve housing mill and finished as described in point 1.



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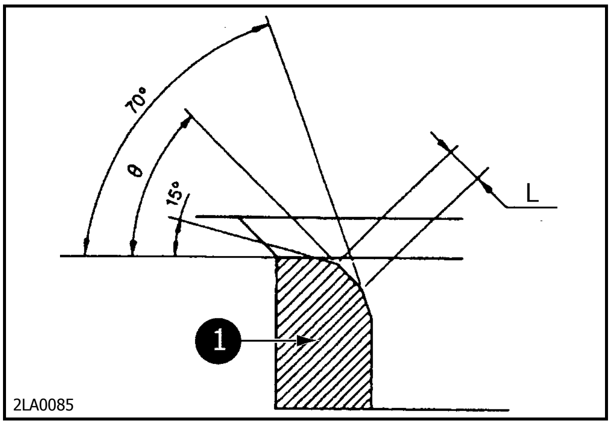
Grinding and milling tool use procedure

1. Correct the roughness of the valve housing surface with a grinder or milling tool.

Grinder	Angle (θ)
Intake valve	30°
Exhaust valve	45°

2. When the width (L) of the valve housing (1) is more than the initial value, correct it by grinding the surface with a grinder held at 70° or with a milling tool. After this, grind the housing with a grinder held at 15° until the normal width is obtained.

> If a milling tool is used, apply an even pressure and avoid moving the tool in a discontinuous way.



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3. Soften the valve compound by mixing it with oil and finish the valve housing by lapping.

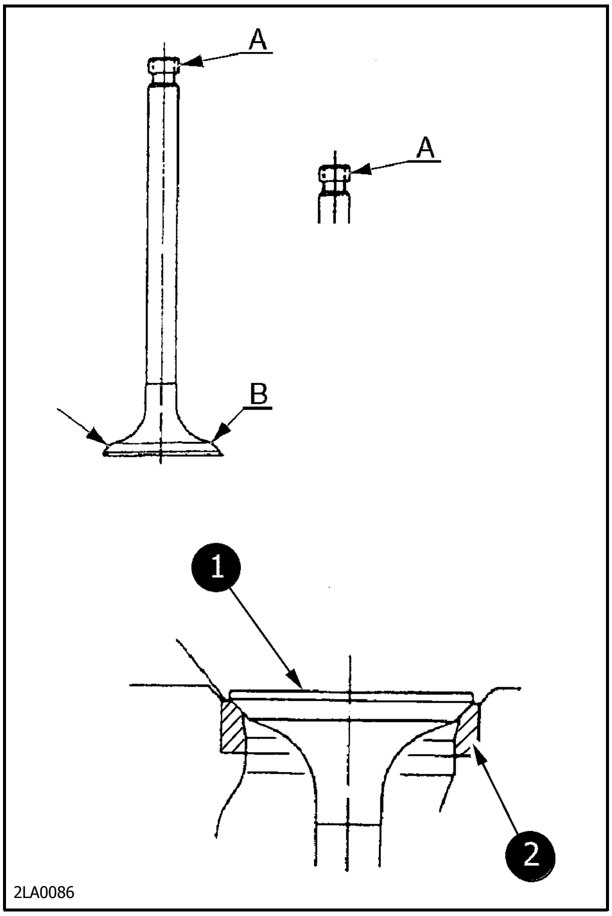
> Before working on any of the valves, make sure that you have measured the gap between the outer diameter of the valve stem and the inner diameter of the valve guide. If the gap exceeds the required limit, replace the valve or valve guide before working on the surface of the housing. (The assembly play between the valve and valve guide is given on page 7).

4. Terminate by lapping the valve with oil only.

> 1. After the work on the valve housing has terminated, thoroughly clean it and the cylinder head with diesel fuel or another similar product. Carefully remove the valve or surfacing compound.
> 2. Repeat points 3 and 4 if the contact is poor.

Valve housing removal

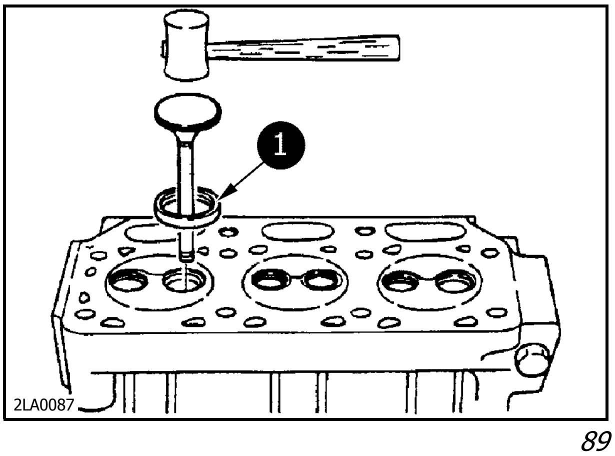
1. Grind the circumference of the intake/exhaust valve head in area B to obtain a smaller outer diameter of the valve housing.
2. Grind the circumference of the valve stam end in area A until the same dimensions of the cotter housing race diameter are obtained.
3. Weld the intake/exhaust valve head (1) to the housing (2) in three points.
4. Tap on the end of the intake/exhaust valve stem to extract the valve housing.



88

Valve housing insertion

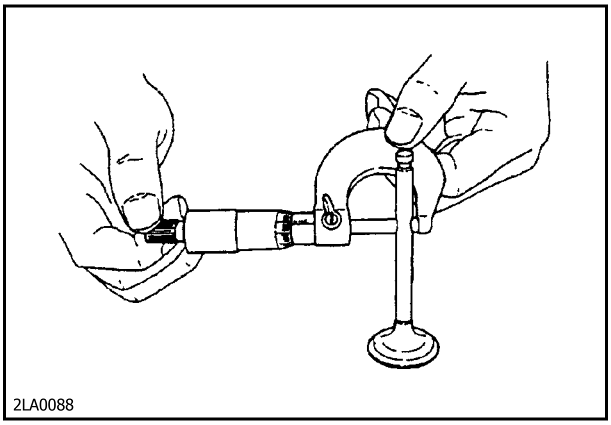
1. Place the valve housing (1) in a vessel containing liquid nitrogen, ether or alcohol and dry ice in order to cool it sufficiently.
2. Heat the cylinder head around the valve housing to 80 - 100°C with a drier.
3. With the new intake/exhaust valve, firmly insert the sufficiently cooled valve housing into the cylinder head, tapping lightly on the valve head.
4. Allow the cylinder head to cool down to a normal temperature.



89

Valve stem wear and warping

Replace the valve stem if it is very curved or worn. In this case, also replace the valve guide.



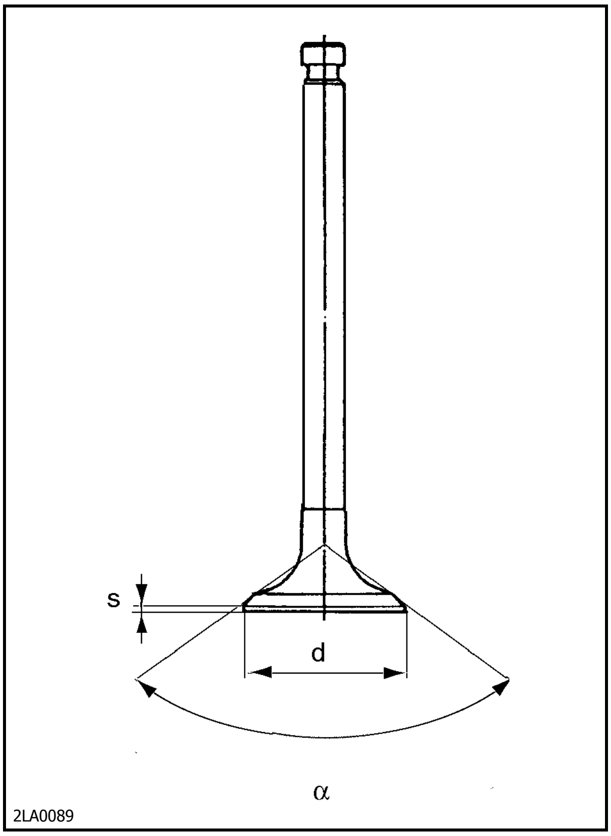
90

Valve stem and valve guide

The assembly play is the difference between the inner diameter (I.D.) of the valve guide measured with a three-point micrometer (able to measure an inner diameter between 4 mm and 8 mm) or a cylinder gauge (able to measure an inner diameter of 6 mm or more) and the external diameter (E.D.) of the stem, measured with a micrometer. Replace both the intake/exhaust valve and the valve guide when the play is near to the limit value.
Compare the results obtained with the standard values given on page 10.

Valve head thickness

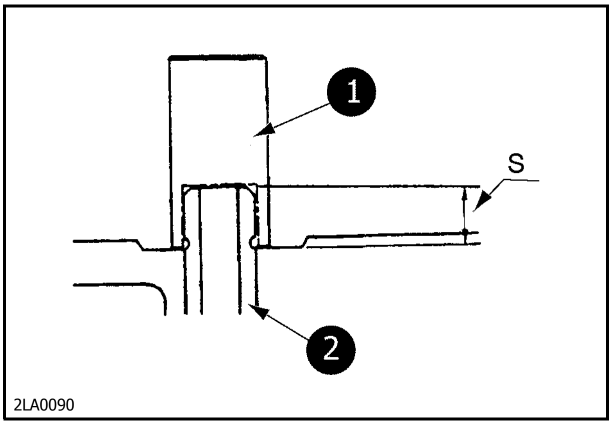
Measure the thickness (S) of the valve head with a micrometer.
Replace the valve if the measured value is near to the wear limit.
Compare the results obtained with the standard values given on page 10.



91

Valve guide replacement

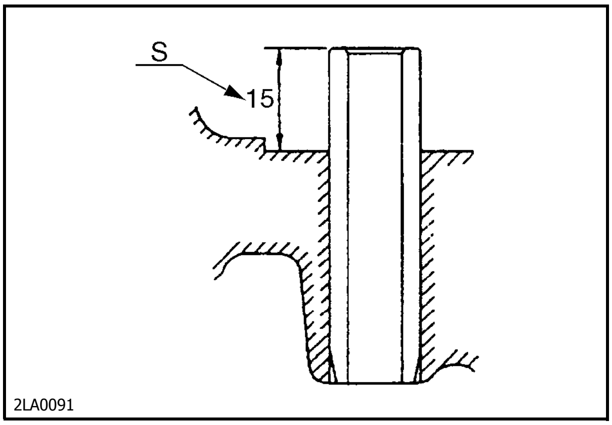
1. Remove the valve guide (2) from the cylinder head with the relative puller **006 MT MIS** (1).
2. Place the valve guide in a vessel containing liquid nitrogen, ether or alcohol and dry ice in order to cool it. Fit the sufficiently cooled valve guide into the cylinder head and tap it lightly with the relative tool **007 MT MIS** in order to seat it correctly.



92

3. Finish off the inside after the valve guide has been inserted.
4. Check the projection (S) of the valve guide.

Compare the obtained results with the standard values given in the table on page 10.



93

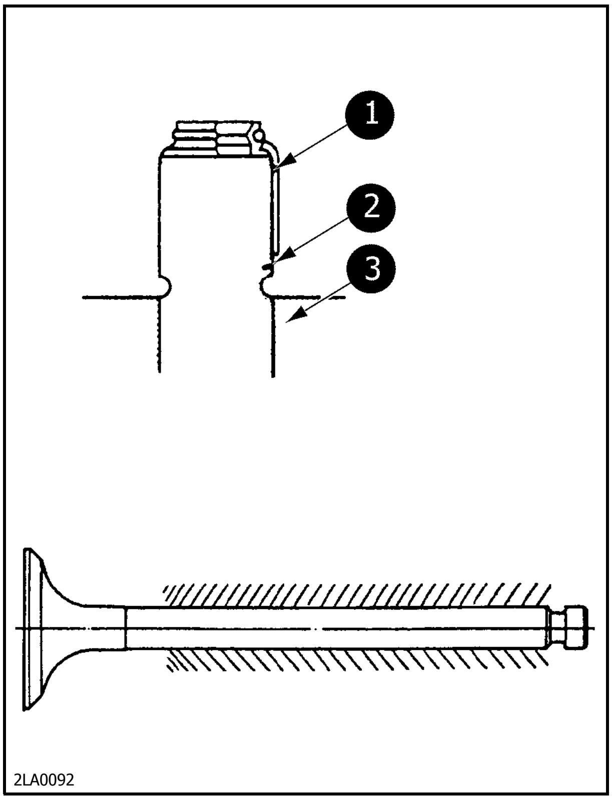
Valve stem seal

Replacement frequency

- When the oil leaks are excessive.
- When the seal has been removed from the valve stem.
- When the intake valves are removed.

Precautions for installation.

Make sure that the entire valve stem surface is smooth and apply a film of lubricating oil to the stem before remounting the valve.



94

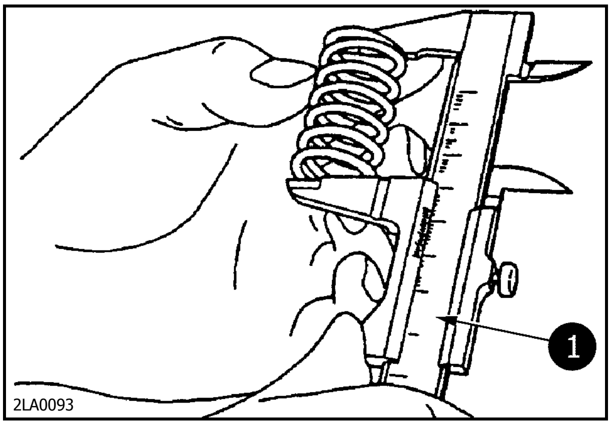
Key

1. Valve shank seal
2. Valve guide
3. Cylinder head

Valve spring inspection

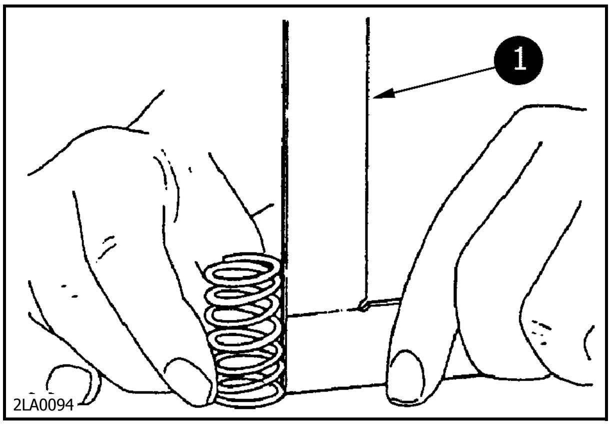
1. Check to make sure that the valve spring is not cracked or corroded.

2. Use a gauge (1) to measure the free length (length of the spring) and its slant (squareness of the coil side) using the square (1, fig. 96).

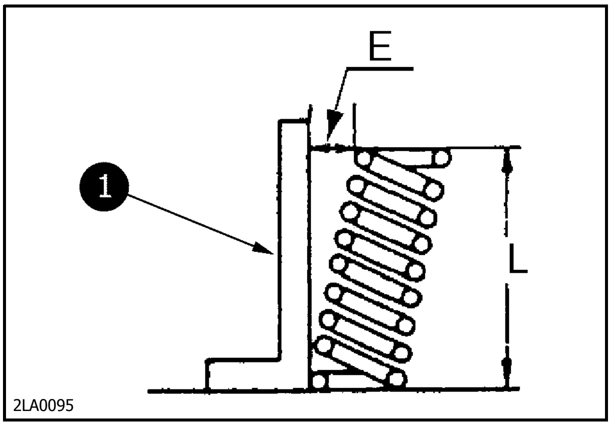


95

Compare the obtained results with the standard values given in the table on page 10.



96



97

Key
1. Square
2. Slant error
3. Free length

Spring cap and cotter inspection

Check the contact between the inner surface of the spring cap and the circumference of the cotter, and the contact between the inner surface of the cotter and the race on the head of the valve stem. If the contact is irregular or the cotter has lowered, replace it with a new one.

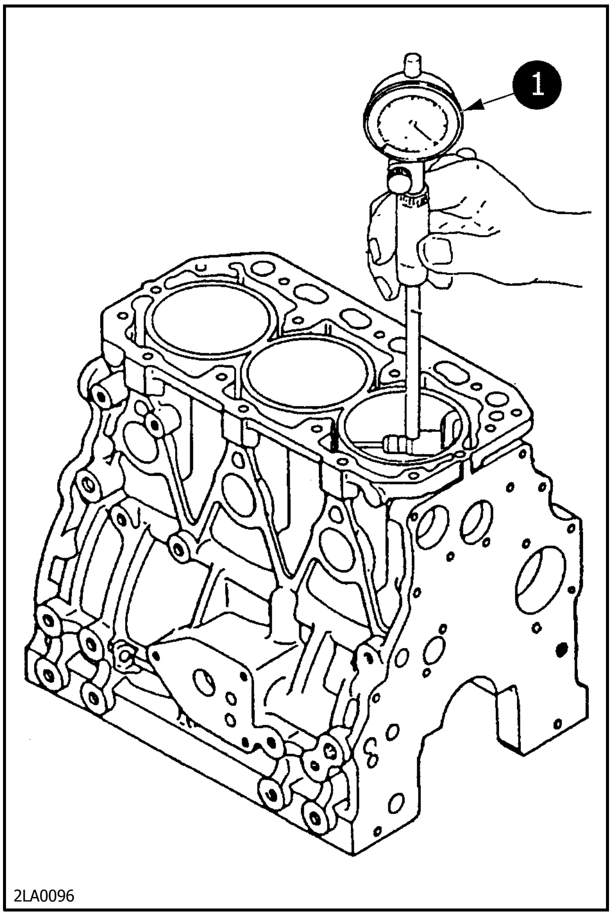
CRANKCASE AND CYLINDER LINER INSPECTIONS, MEASUREMENTS AND REPAIRS

> Thoroughly clean the parts before proceeding with the inspections.

> Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Crankcase inspection

1. Check to make sure that there are no water or oil leaks or cracks in the crankcase. If you think that there may be cracks, check with a special colouring substance able to detect cracks that are not visible to the naked eye.
2. Replace the crankcase if it is seriously or irreparably damaged.
3. Thoroughly clean all oil holes. Make sure that they are not clogged.



98

Measurement of cylinder liner bore and warping

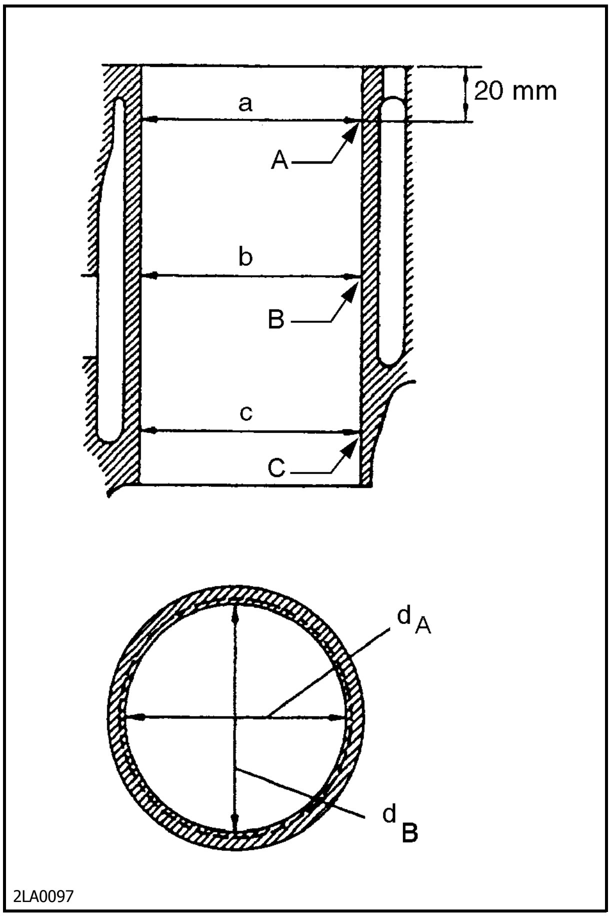
Measure the bore of each cylinder with a bore gauge (1, fig. 98). Measure the cylinder in point A, about 20 mm under the liner tip and in points B and C, at the same distance (AB = BC).

> The measurements must be made in A, B and C along directions d_A and d_B.

Calculate the warp (roundness and cylindricity of each cylinder) using values measured in the following way:

- Roundness:
  Difference between the maximum and minimum bore values in the same radial section of each liner.
- Cylindricity
  Difference between the maximum and minimum bore values along the liner axis.

Lapping (lapping and reaming) must be carried out when the values measured exceed that limit.



99

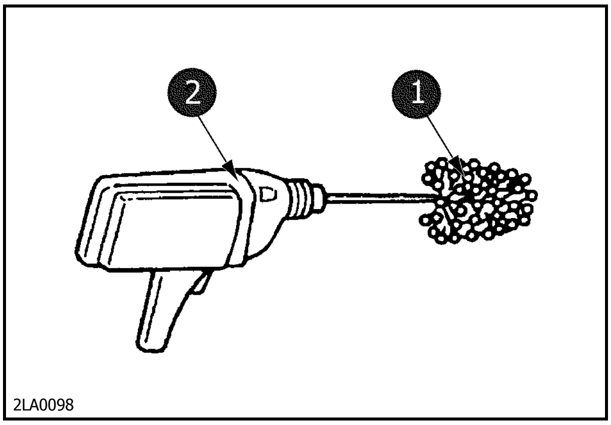
> For oversized pistons and piston rings, see pages 9 and 10.

Compare the obtained results with the standard values given in the table on page 8.

Lapping

Lapping procedure

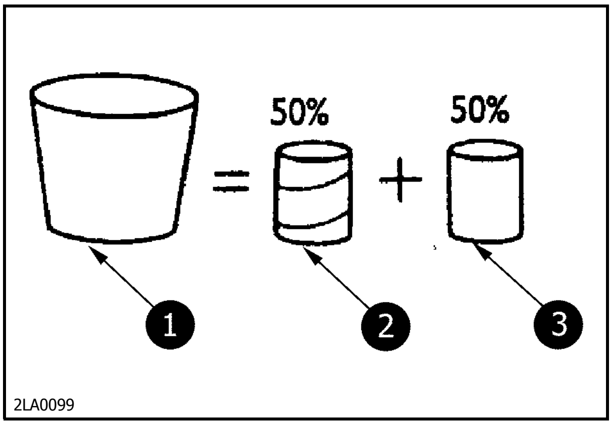
Lap or ream the cylinder in the case of irregular wear, defects or other types of damage. Slight and irregular wear, small cracks, etc., can be smoothed with a flexible fine-finishing brush (1) mounted on an electric drill (2). If the wear is greater and more irregular, it is advisable to ream and then lap the cylinder. It is important to evaluate whether the cylinder can become perfectly round after lapping, reaming or both, and to bear the maximum wear degree in mind. Moreover, also carefully check out whether oversized piston rings and pistons can be used.



100

Use of the flexible fine-finishing brush

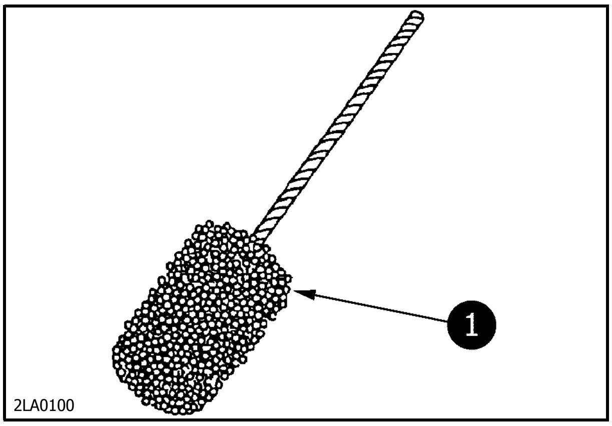
It is advisable to use a flexible fine-finishing brush for surfacing purposes.



101

Tools required

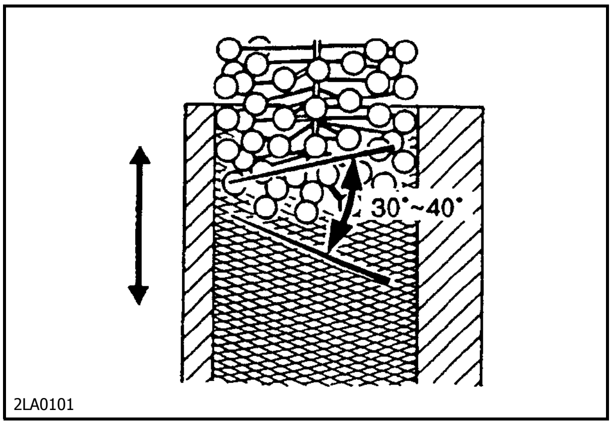
Flexible brush for fine-finishing (1), electric drill and surfacing liquid (1, fig. 101) made from a mixture of 50% engine oil (2, fig. 101) and diesel fuel (3, fig. 101).



102

Instructions for use

1. Apply the surfacing liquid to the flexible fine finishing brush.
2. Start the brush turning and move it into the cylinder, working up and down for about 30 sec at an angle of 30 - 40°, as indicated by the cross-hatched area in the figure.
3. Remove the brush from the cylinder while it is still turning.



103

WARNING

- Use the flexible fine-finishing brush at a speed of 300 - 1200 RPM. Use of the brush at a higher speed could be dangerous.
- Never move the brush into the cylinder or take it out when the electric drill is off.

ROCKER ARM INSPECTIONS, MEASUREMENTS AND REPAIRS

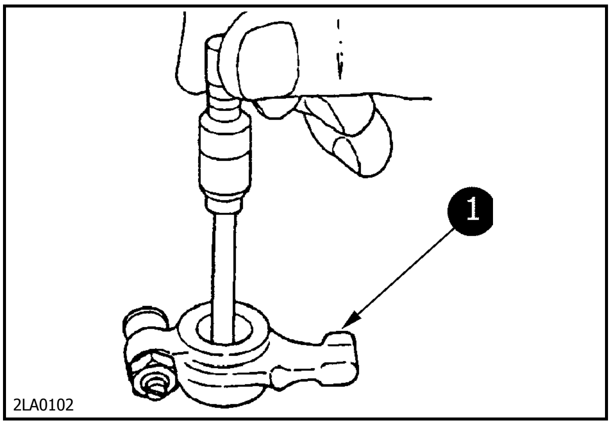
Thoroughly clean the parts before proceeding with the inspections.

Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

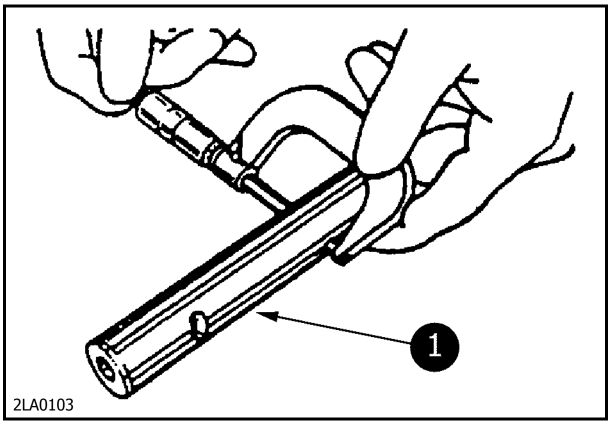
Measurement of the outer diameter of the rocker arm pin and inner diameter of the rocker arm

The assembly play is the difference between the inner diameter of the rocker arm (1) measured with a cylinder gauge and the outer diameter of the rocker arm pin (1, fig. 105), measured with a micrometer. When the assembly play is near to its limit, the pin and rocker arm must be replaced.

Compare the obtained measuring results with the standard values given in the table on page 11.



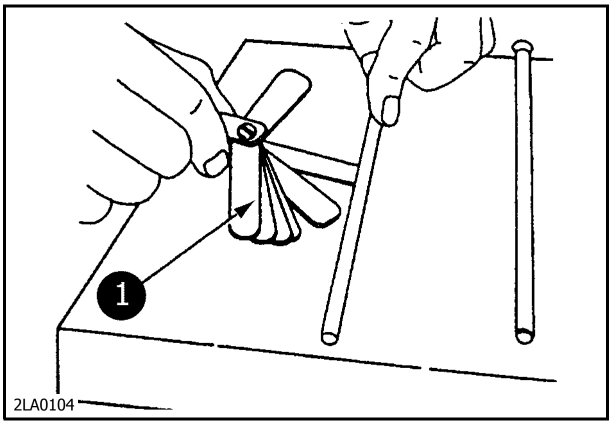
104



105

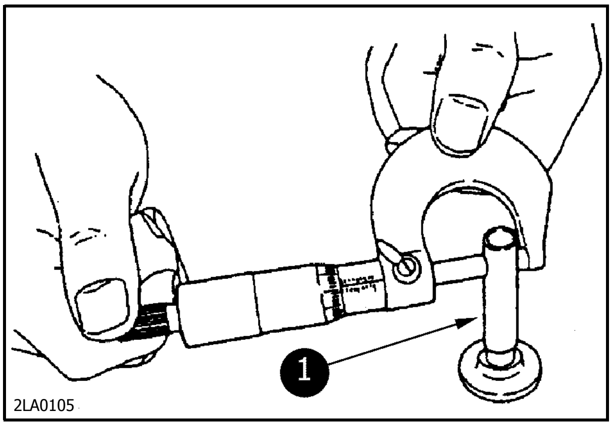
Tappet rod curve inspection, measurement of the outer diameter of the tappets and inspection of the contacting surfaces

Place the tappet rod on a surface plate and, using a thickness gauge (1) as shown in the figure, measure the distance between the rod and the surface itself. Also measure the outer diameter of the tappets (1, fig. 107) with a micrometer.



106

Compare the obtained measuring results with the standard values given in the table on page 11.



107

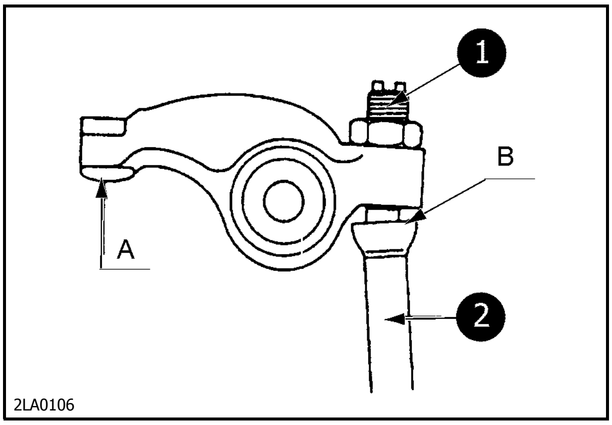
Other inspections

Rocker arm pin spring

Check to make sure that there are no traces of corrosion or wear on the rocker arm pin spring. Replace it if this is the case.

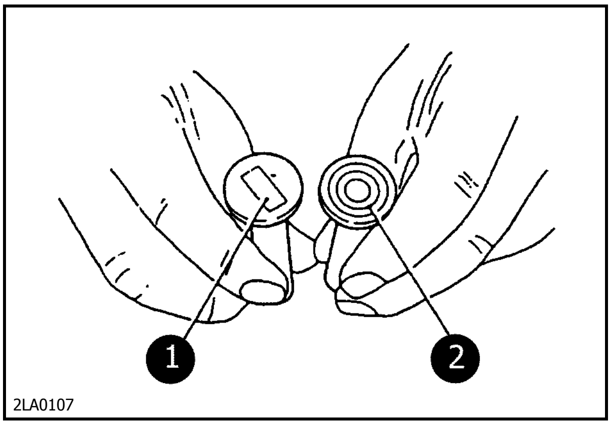
Wear on the rocker arm pad (area A) and intake/exhaust valve cap.

Check the contact surfaces of the intake/exhaust valve rocker arm pad. Replace them if one of the two shows signs of abnormal wear or flaking.



108

Check the point in which the valve play adjuster screw (1, fig. 108) touches the tappet rod in area B. Replace the rod (2, fig. 108) or the adjuster screw (1, fig. 108) if it appears worn or flaking (see fig. 109).



109

Valve wear:

1. Irregular contact surface.
2. Regular contact surface.

PISTON AND PISTON RING INSPECTIONS, MEASUREMENTS AND REPAIRS

Thoroughly clean the parts before proceeding with the inspections.

Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Piston inspection

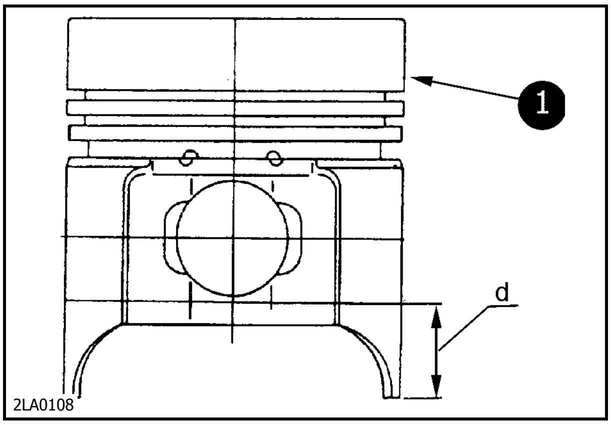
1. Remove the carbon deposits from the head and from the combustion surface of the piston to prevent it from being damaged. Check to make sure that there are no traces or breakage or other damage.
2. Check the circumference and housing of the piston ring and replace it if it is worn or damaged.

Measurement of the outer piston diameter

Measure the outer diameter of the piston (1) in a vertical direction towards the pin hole and at distance

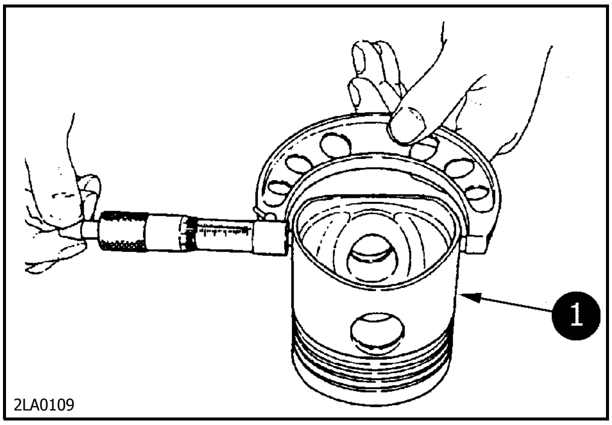
d = 22 - 25 mm

from the bottom end of the piston.



110

Compare the obtained measuring results with the standard values given in the table on page 11.



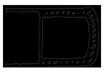
111

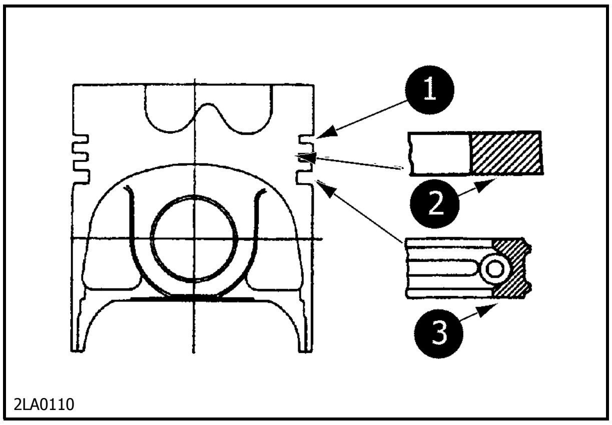
Shape of the piston rings

To identify the piston rings, refer to fig. 112, in which:

1. Upper piston ring.
2. 2nd piston ring (the same for all models)
3. Oil scraper ring (the same for all models)

   The section of the upper piston ring is given in the following table:

Upper piston ring (all models)	

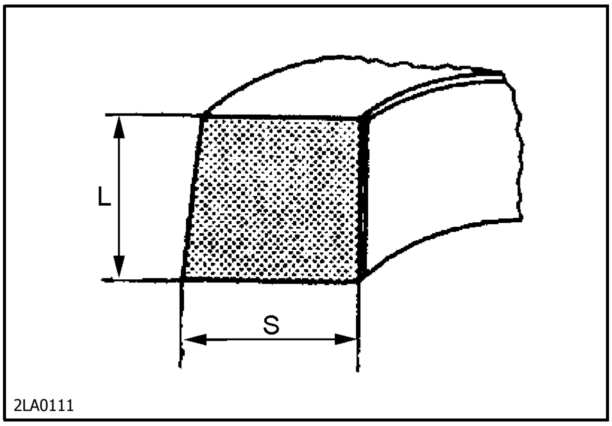


112

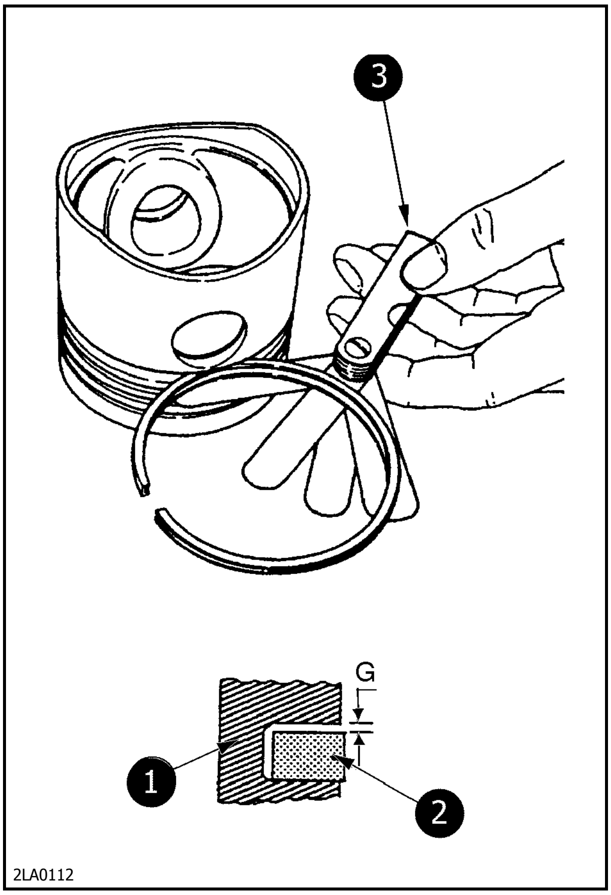
Measurement of the groove width of the piston ring, the piston ring and the distance between ends

1. To measure the width of the groove, first measure the width (L) of the piston ring (2, fig. 114), then fit it into the carefully cleaned groove. Insert a thickness gauge (3, fig. 114) between the piston ring and groove to measure the distance.
2. Calculate the width of the piston ring groove, adding the width of the ring to the measured side play G.

Compare the obtained measuring results with the standard values given in the table on page 13.



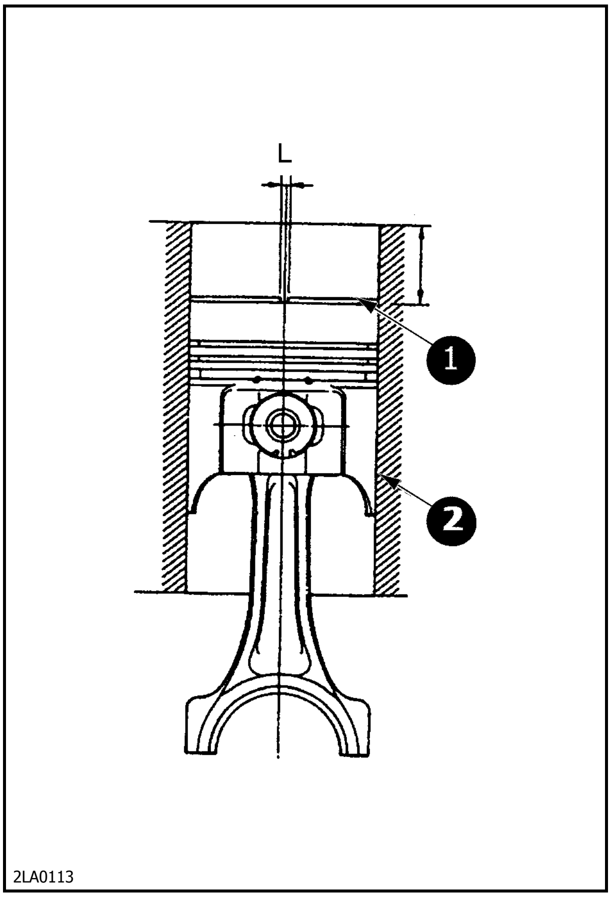
113



114

To measure the distance between the ends, push the piston ring (1) into the cylinder liner (2) using the piston head, and insert a thickness gauge into the gap. If the cylinder liner is worn, measure the distance (L) between the ends after having pushed the piston ring in the point in which the cylinder liner is less worn (about 30 mm from the bottom end of the cylinder liner).

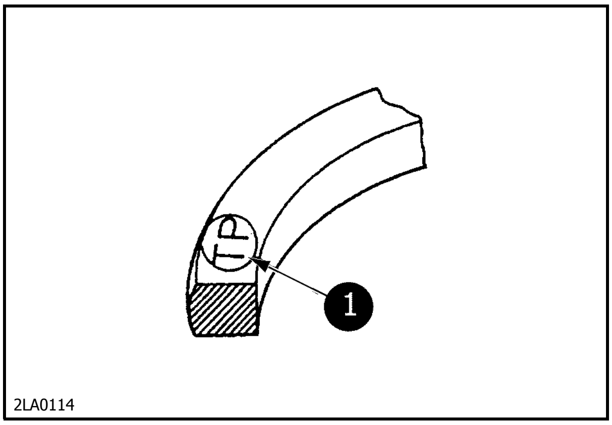
Compare the obtained measuring results with the standard values given in the table on pages 13 and 14.



115

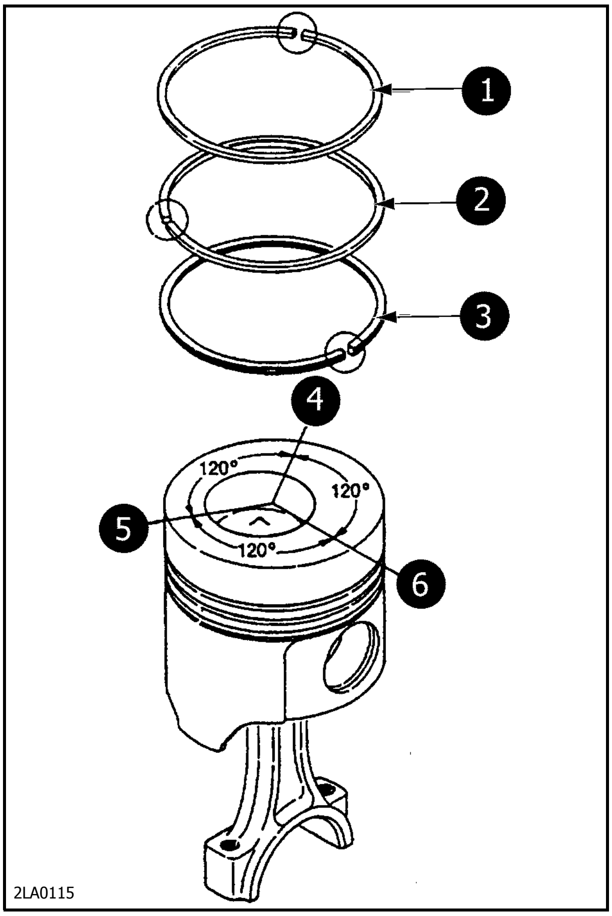
Piston ring assembly

1. Use tool **004 MT MIS** and insert the piston ring into the groove, with the manufacturer's mark (1) near the piston ring joint pointing towards the combustion chamber side. When the spring ring has been fitted, make sure that it is free to move.



116

2. Stagger the gaps between the ends of the piston rings at intervals of 120°, making sure that they are not aligned along the piston. Lubricate the circumference of the piston with oil.



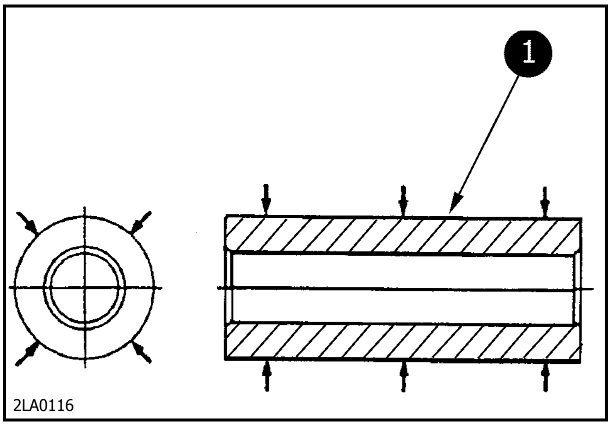
117

Key
1. Upper piston ring.
2. 2nd piston ring.
3. Oil scraper ring
4. Position of the upper piston ring joint.
5. Position of 2nd piston ring joint.
6. Position of the oil scraper ring joint.

Measurement of the outer diameter of the pin and relative hole

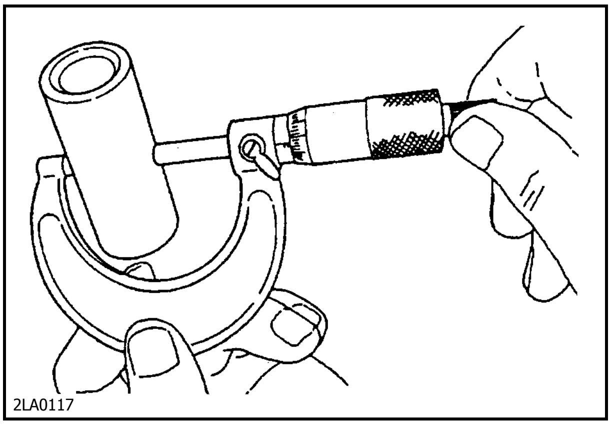
1. Measure the outer diameter of the pin (1) and hole in the points indicated by the arrow.

   Compare the obtained measuring results with the standard values given in the table on page 12.



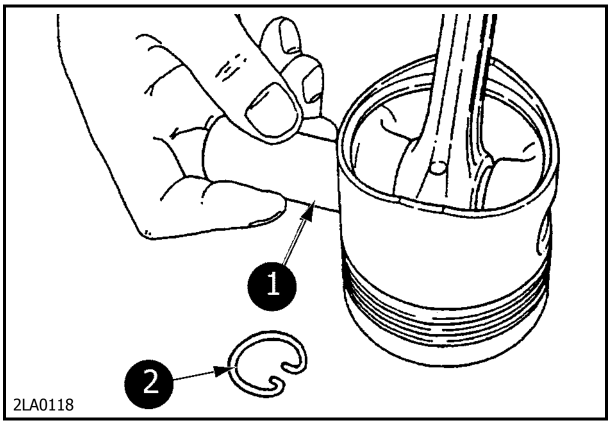
118

2. Replace the pin if it is too worn.



119

Lubricate the pin (1) with oil before fitting it into the piston. Now position the piston ring (2) in the piston housing.



120

CONNECTION ROD INSPECTIONS, MEASUREMENTS AND REPAIRS

Thoroughly clean the parts before proceeding with the any of the operations.

Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

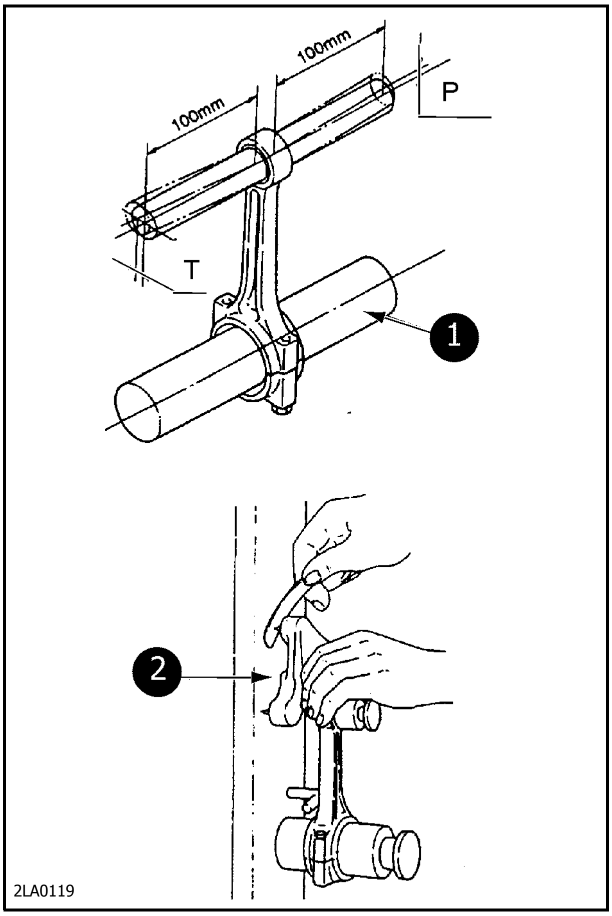
Visual inspection

Check the area near to the edge in the chamfered part and the shaped part between the big end and small end of the connecting rod. Also check the area near the oil hole of the small end bush to make sure that there are no signs of cracks, warping or discolouring.

Twist and parallelism measurement

Measure the twist (T) and parallelism (P) by using a connecting rod aligner (2).

Compare the obtained measuring results with the standard values given in the table on page 14.



121

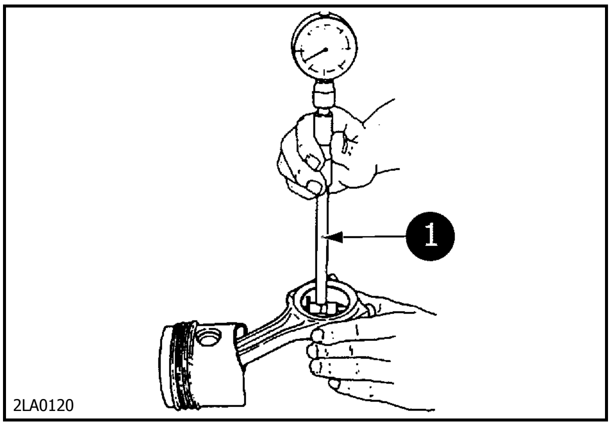
Measurement of the bush and connecting rod pin play

1. To measure the connecting rod pin and bush gap, measure the inner diameter of the bearing and the outer diameter of the connecting rod pin, then calculate the difference between the two values.

> To measure the inner diameter of the connecting rod pin bearing, mount this latter on the connecting rod and tighten the bolt to the prescribed torque value, i.e.
>
> 44.1 - 54.0 Nm
>
> checking to make sure that each of the bearings is mounted in the right position. After this, measure the dimension with the gauge (1).

Compare the obtained measuring results with the standard values given in the table on page 14.

2. Replace the connecting rod pin bearing if the gap measured is near to the wear limit or exceeds it. If the bearing is irregularly or excessively worn, grind the connecting rod pin and use an oversized bearing.

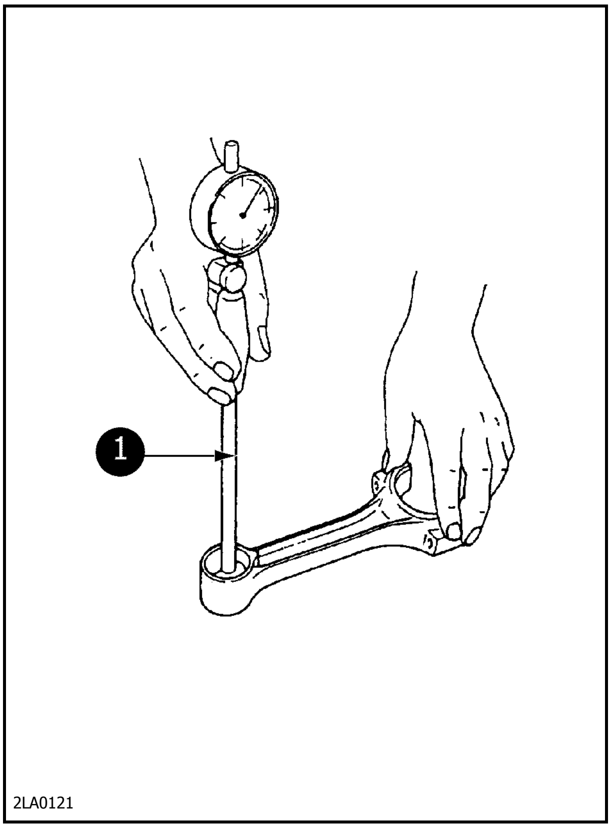


122

Measure the play between the pin bush and the pin itself

Use a cylinder gauge (1) to measure the play. Measure the inner diameter of the pin bush and the outer diameter of the pin and note down the difference between the two values.

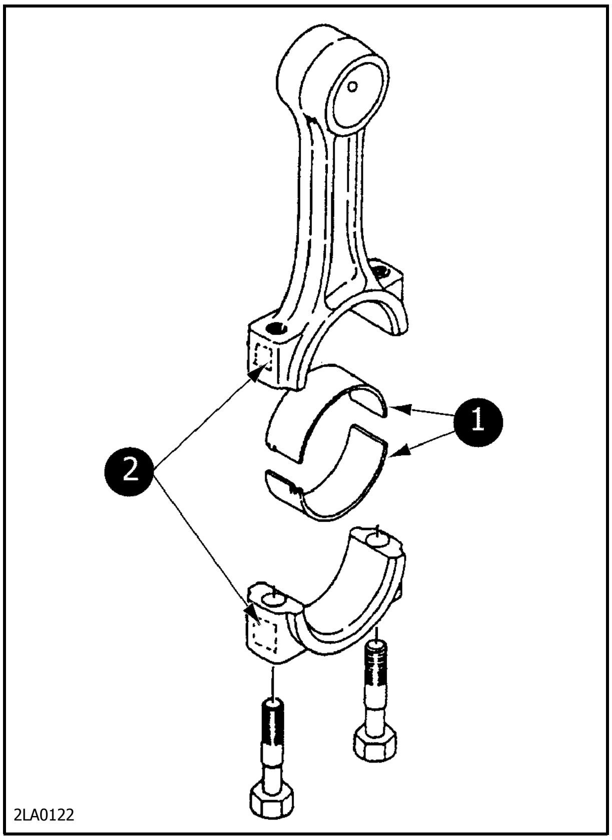
Compare the obtained measuring results with the standard values given in the table on page 14.



123

Checking the connecting rod pin bearing contact

Make a mark with blue ink on the upper surface of the connecting rod pin bearing (1). Fit the bearing in the connecting rod and tighten the bolt on to the drive shaft to the indicated torque value (see page 15) to check the bearing contact. The connecting rod pin bearing contact is acceptable if the blue coloured contact surface occupies 75% of the total surface or more.

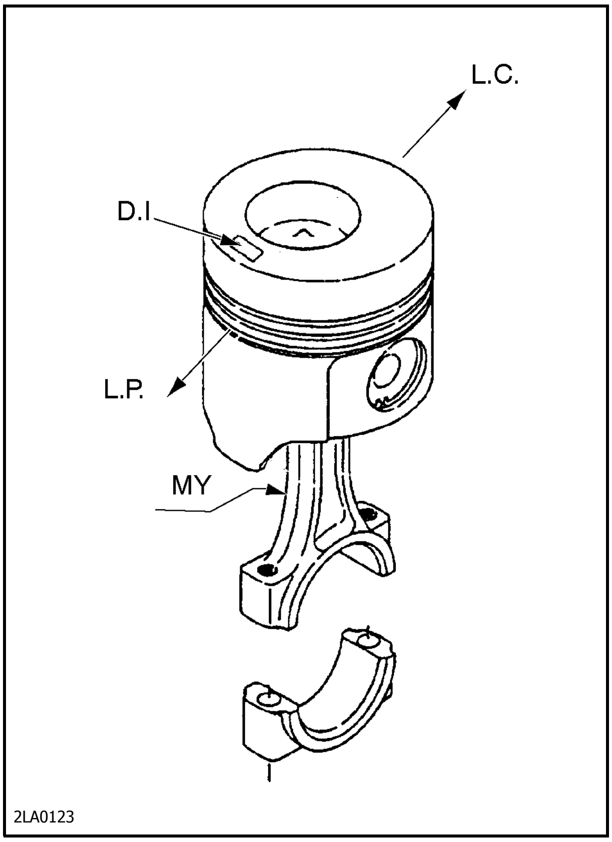


124

Mounting the piston and connecting rod

Mount the piston with the connecting rod, with the mark (2, fig. 124) punched on the big end pointing towards the fuel injection pump. Mount the piston so that the combustion chamber cavity (and the D.I. mark) are on the injection pump (L.P.) side, viewed from above.

Key
L.C. = Camshaft side
L.P. = Injection pump side
M.Y. = Yanmar trademark
D.I. = Code



125

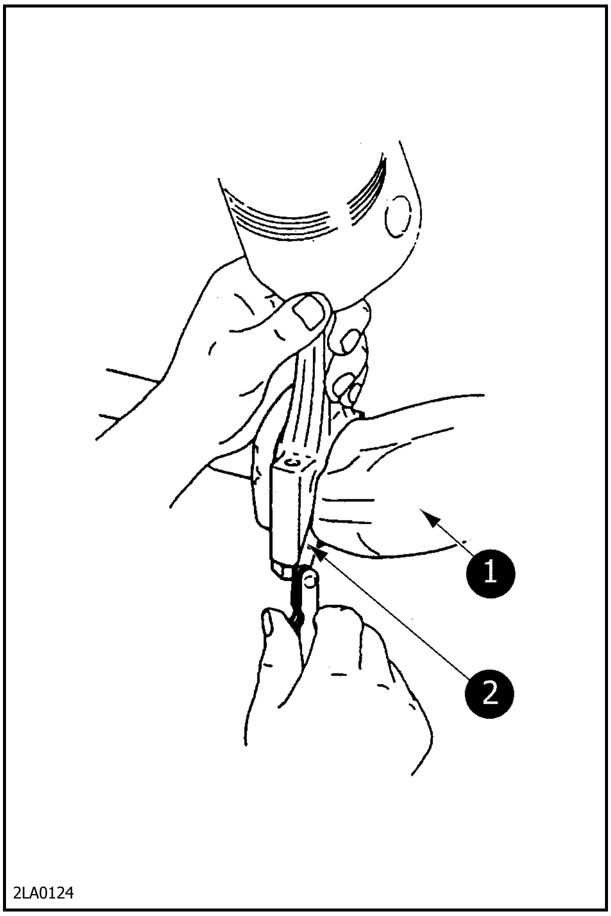
Connecting rod side play

1. After having mounted the connecting rod on the drive shaft (1), tighten the connecting rod cap fixing bolts to the indicated torque value (see page 14).

2. Measure the side play by inserting a thickness gauge (2).

Compare the obtained measuring results with the standard values given in the table on page 12.

3. Replace the bearing of the connecting rod if the value is higher than normal.



126

CAMSHAFT INSPECTIONS, MEASUREMENTS AND REPAIRS

Thoroughly clean the parts before proceeding with the any of the operations.

Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Camshaft float

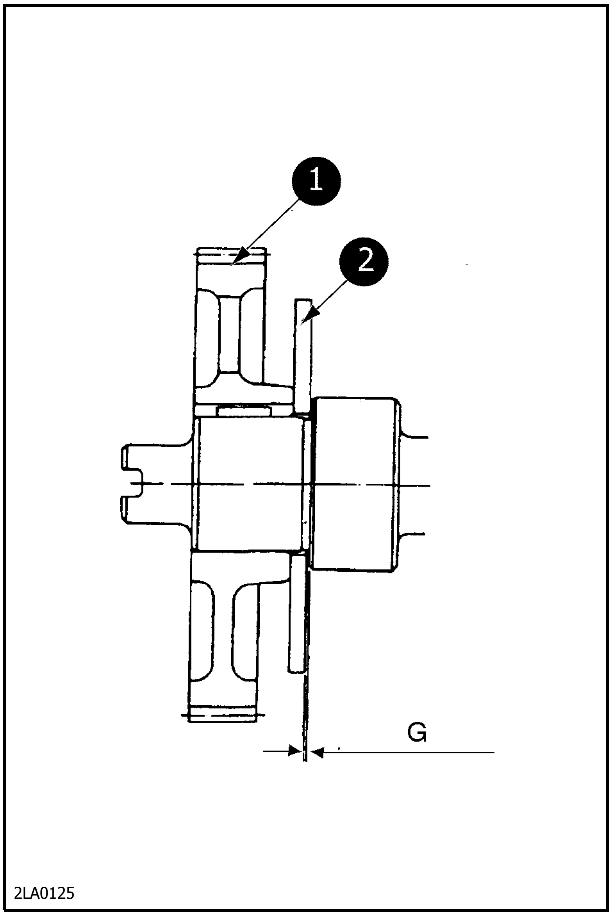
1. before removing the camshaft, measure its float (4) by placing a comparator against the gear (1).

Compare the obtained measuring results with the standard values given in the table on page 15.

2. Replace the thrust shim (2) if the measured value exceeds the tolerated limit.

Visual inspection of the camshaft

Check the tappet contact surface on the cam. Make sure that the bushes are not worn or seized and that the camshaft gear (1) is not damaged.

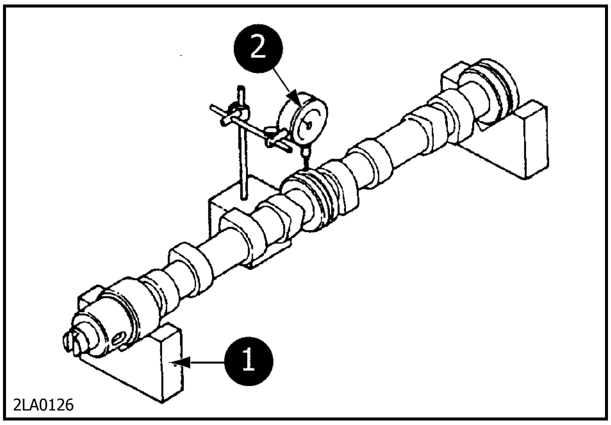


127

Camshaft incurvation measurement

1. Support the camshaft with V-blocks (1).
2. Using a comparator (2), measure the eccentricity of the main journal in the center of the camshaft, by allowing this shaft to turn.
3. Consider 50% of the measured eccentricity as incurvation value.

Compare the obtained measuring results with the standard values given in the table on page 15.



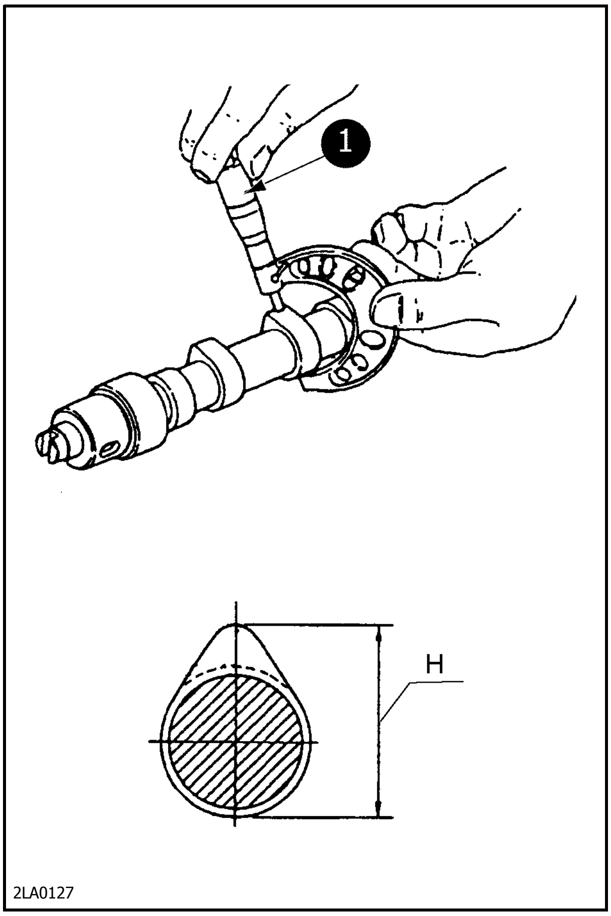
2LA0126

128

Intake/exhaust cam height measurement

1. Make the measurements by positioning the micrometer (1) as shown in the figure.
2. Compare the obtained measuring results with the standard values given in the following table.

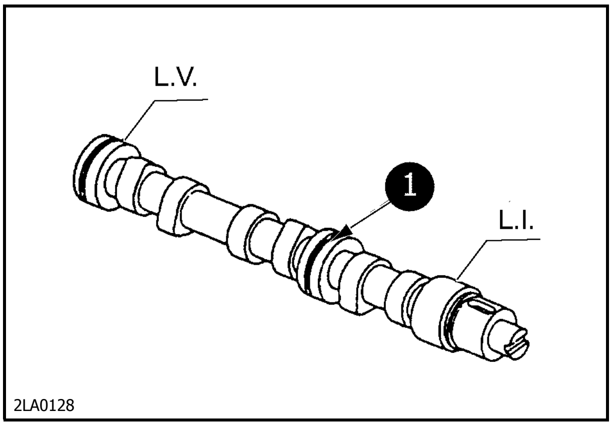
		MISTRAL AMERICA 40-45-50	
		Value nominal (mm)	Value at limit of wear (mm)
Cam height (H)	Intake cam	38.635 - 38.765	38.40
	Exhaust cam	38.635 - 38.765	38.40



2LA0127

129

Measurement of the play between the camshaft pins and their relative bushes



130

1. Measure the outer diameter of the camshaft pins with a micrometer, in the positions shown in figure 130.
2. Measure the inner diameter of the bush with a hole gauge after having inserted it into the engine block.
3. Calculate the play according to the distance between the inner diameter of the bush and the outer diameter of the pin.

Compare the obtained measuring results with the standard values given in the table on page 15.

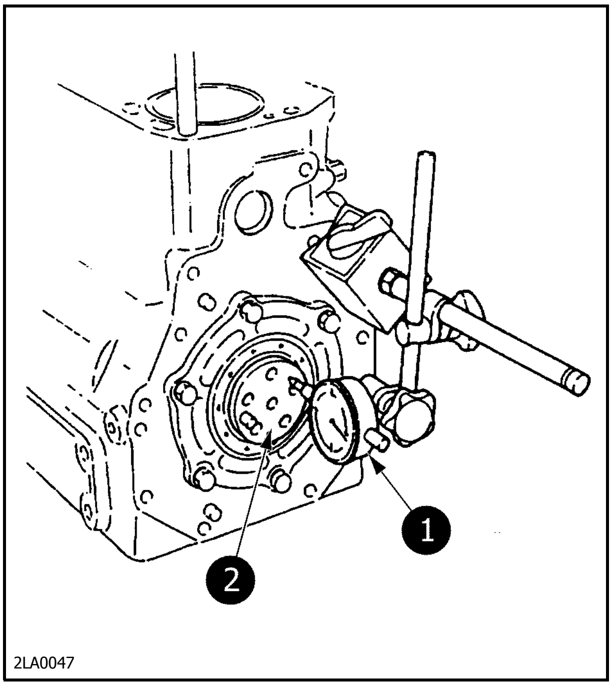
Key
L.V. = Flywheel side
L.I. = Gear side

DRIVE SHAFT INSPECTIONS, MEASUREMENTS AND REPAIRS

> Thoroughly clean the parts before proceeding with the any of the operations.

> Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Drive shaft float



131

1. Place a comparator against the end of the shaft before removing the actual drive shaft and at the moment of assembly.
2. Force the drive shaft on both sides in an axial direction to measure the play. Alternatively, insert a thickness gauge directly between the bearing ring on the support and the shaft itself, in order to measure the float.

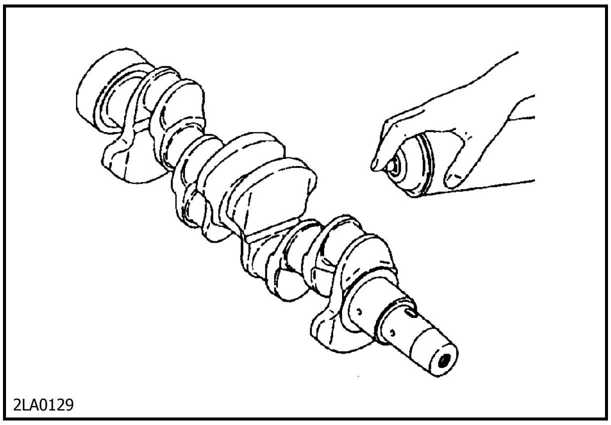
If the value exceeds the limit one, i.e.:

0.090 - 0.271 mm

replace the bearing ring.

Checking the colour of the drive shaft

1. Clean the drive shaft and check it with a colouring substance to make sure that there are no cracks too small to be seen by the naked eye, or with a Magnaflux system (magnetic crack detector).
2. Replace the drive shaft if it is cracked or seriously damaged. Repair or grind the shaft if it is only slightly damaged.



132

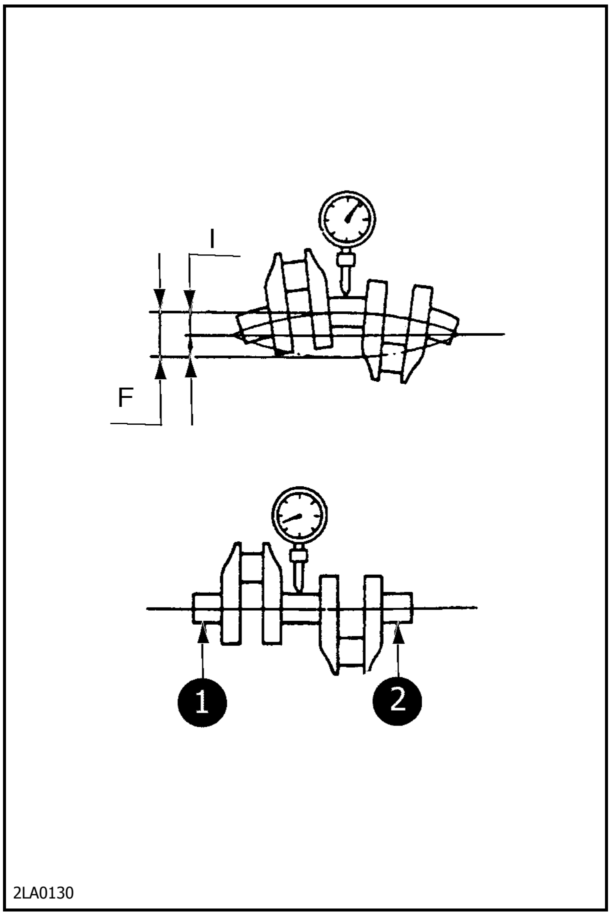
Bearing inspection

Make sure that the bearings do not show signs of flaking, fusion or seizing and check the condition of the contact surface. Replace the bearings if they are defective.

Drive shaft incurvation

1. Place V-blocks (1) and (2) at both ends of the main journals.
2. Measure the eccentricity of the central main bearing with a comparator while turning the drive shaft, and make sure that its incurvation value (I) does not exceed the tolerated limit value, i.e.:

   0.02 mm

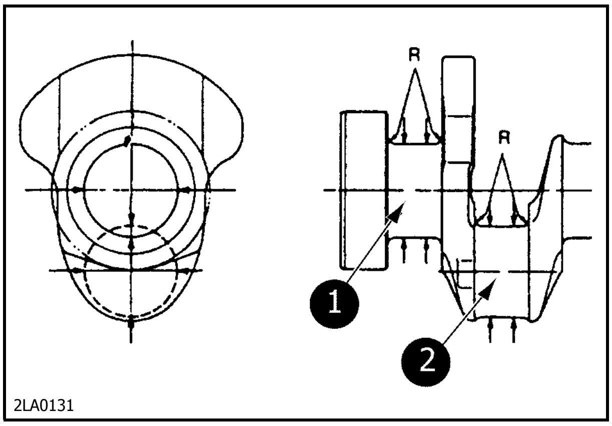


133

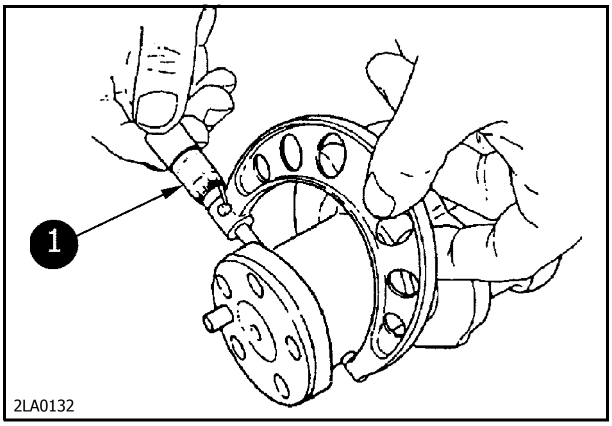
Measurement of the connecting rod pin and main bearing

1. Using a micrometer (1, Fig. 135), measure the outer diameter, the roundness and taper of the connecting rod pin and that of the main journal. Check in the points shown by the arrows in figure 134.

   Compare the obtained measuring results with the standard values given in the tables on pages 14 and 15.



134

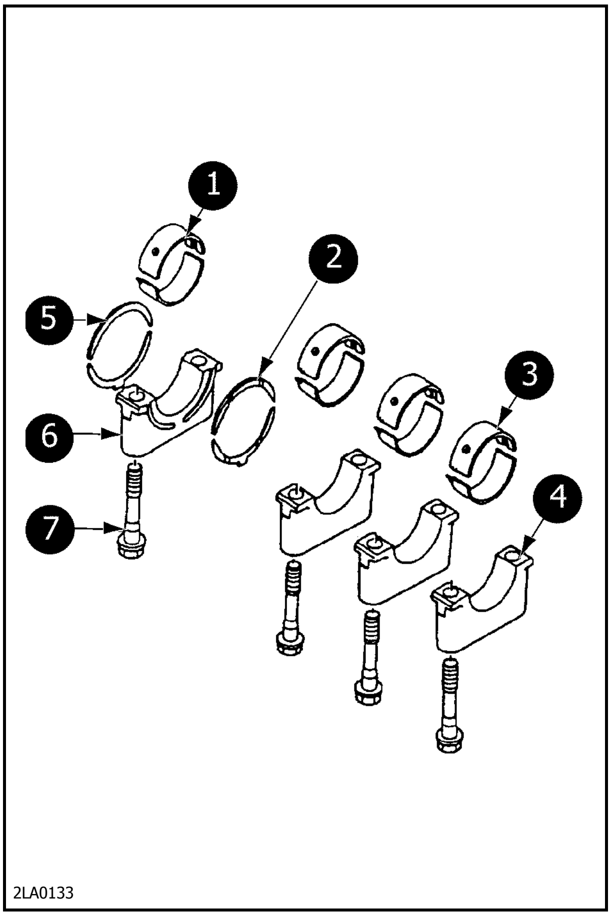


135

2. The pins can be ground if the irregular wear or roundness exceed the tolerated limit, but the value of the outer diameter is within the limits.
3. Replace the drive shaft if it is not possible to return within the tolerated values even after grinding.
   A 0.25 mm oversized bearing is available for the connecting rod pin.

Precautions for bearing assembly

- Remember that the lower half bearing of the main bearing (cap side) does not have an oil groove.
- Consider that the upper half bearing of the main bearing (cylinder block side) has an oil groove.
- Check the alignment order in the cylinder block.
- Position the "FW" mark on the main bearing cap towards the flywheel side.
- Position the thrust shims towards the flywheel.



136

Key

1. Main bearings (basic).
2. Thrust shims (gear side).
3. Main bearings.
4. Main bearing cap.
5. Thrust shims (flywheel side).
6. Main bearing cap (basic).
7. Main bearing bolt.

GEAR INSPECTIONS, MEASUREMENTS AND REPAIRS

Thoroughly clean the parts before proceeding with the any of the operations.

Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Gear inspections

Check the gears and replace them if their teeth are damaged, worn or cracked.

Play measurement

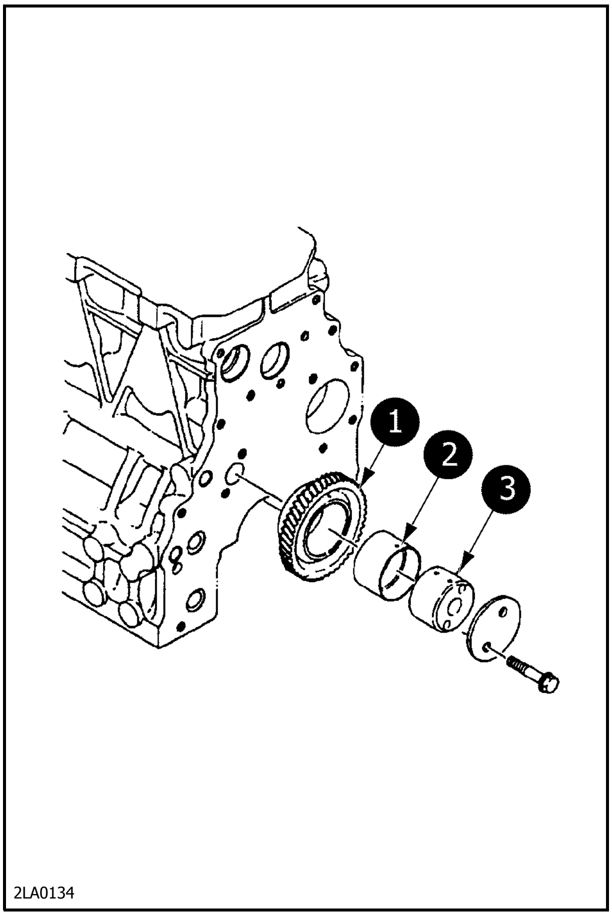
Appy a comparator on the pitch circumference of the gear and measure the play.
Compare the obtained measuring results with the standard values given in the table on page 15.

Checking and measuring the intermediate gear shaft and the gear itself

1. Measure the inner diameter of the bush (2) and the outer diameter of the intermediate gear (1) shaft (3).
Compare the obtained measuring results with the standard values given in the following table.

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">MISTRAL AMERICA 40-45-50</td></tr>
<tr><td>Value nominal (mm)</td><td>Value at limit of wear (mm)</td></tr>
<tr><td rowspan="3">Intermediate gear</td><td>Outer shaft diameter</td><td>45.950 - 45.975</td><td>45.93</td></tr>
<tr><td>Inner bush diameter</td><td>46.000 - 46.025</td><td>46.08</td></tr>
<tr><td>Assembly play</td><td>0.025 - 0.075</td><td>0.115</td></tr>
</table>

2. Replace the bush or the gear shaft if the assembly play exceeds the wear limit.

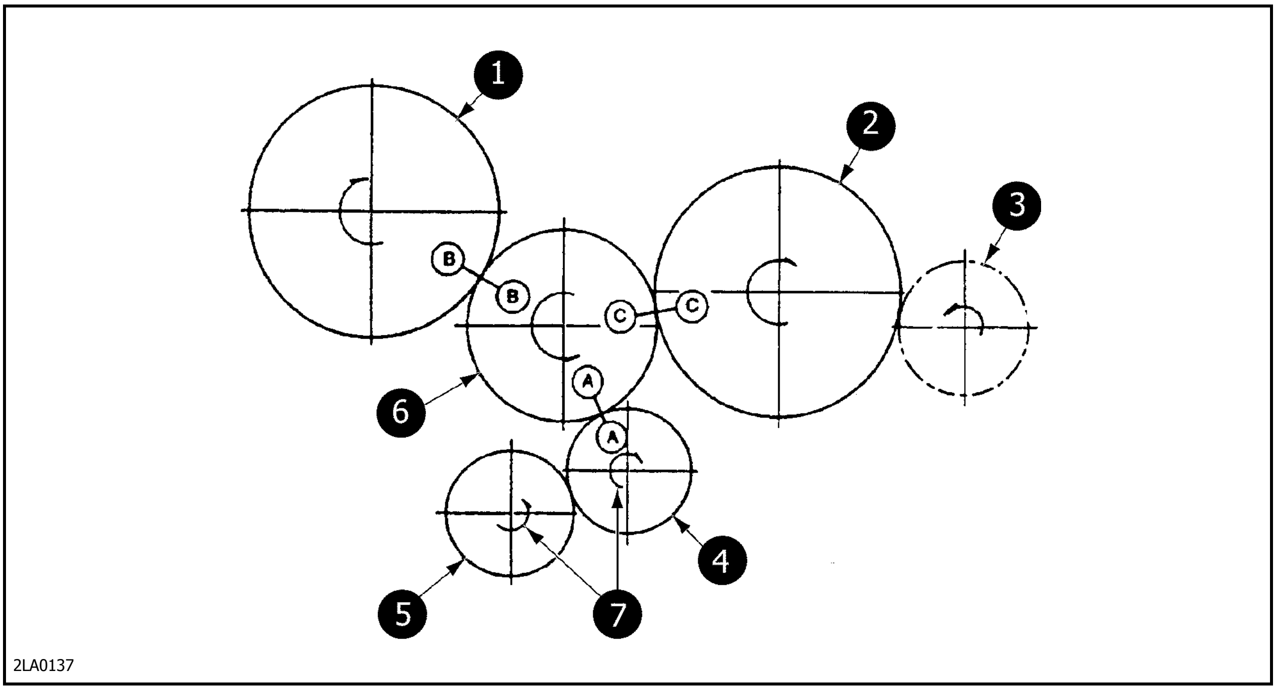


137

3. Check to make sure that the oil hole in the intermediate gear shaft and in the bush is a through hole.

Gear train

After all the gears have been mounted, check to make sure that alignment marks A, B and C of the intermediate gear are aligned with those of the injection pump, camshaft and drive shaft gears.



138

1. Injection pump gear.
2. Camshaft gear
3. Power take-off (on request)
4. Drive shaft gear.
5. Lubricating oil pump gear.
6. Intermediate gear.
7. Rotation direction.

OIL PUMP INSPECTIONS, MEASUREMENTS AND REPAIRS

Thoroughly clean the parts before proceeding with the any of the operations.

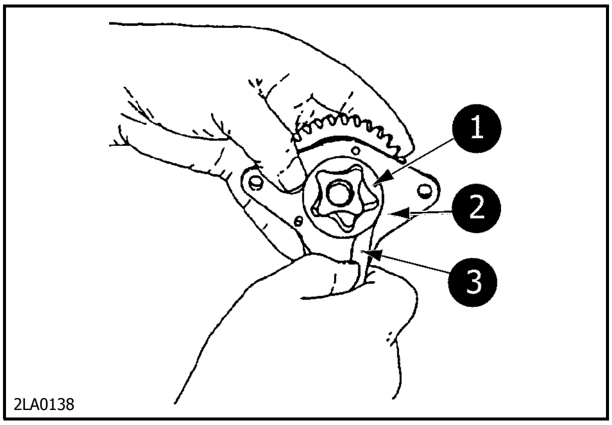
Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Play between the external rotor and pump casing

Insert a thickness gauge (3) between the external rotor (1) and the pump casing (2) and measure the play.

Compare the obtained measuring results with the standard values given below:

Nominal play:	0.10 – 0.16 mm
Play at wear limit:	0.25 mm



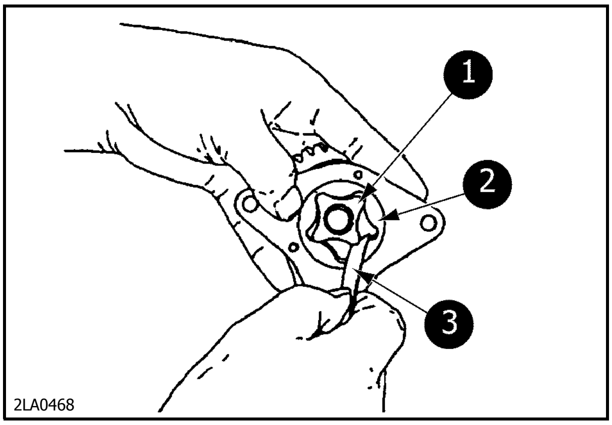
139

Play between inner and outer rotor

Insert a thickness gauge (3) between the upper part of the inner rotor tooth (1) and the upper part of the outer rotor tooth (2) and measure the play.

Compare the obtained measuring results with the standard values given below:

Play at wear limit:	0.15 mm



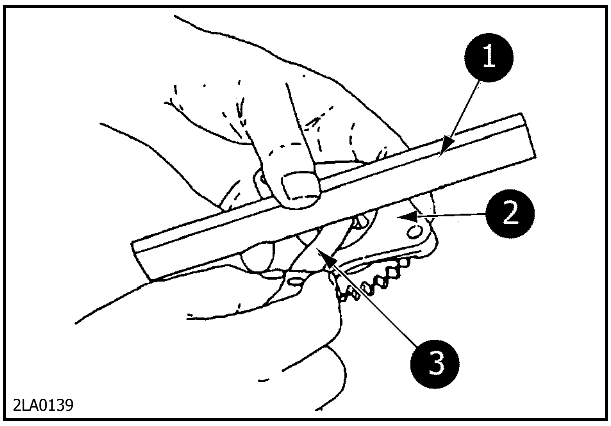
140

Float between the pump casing and the inner and outer rotor

Place a straightedge (1) against the end of the pump (2) and insert a thickness gauge (3) between this and the rotors in order to measure the float.

Compare the obtained measuring results with the standard values given below:

Nominal play:	0.03 – 0.09 mm
Play at wear limit:	0.15 mm



141

Play between the rotor shaft and housing hole

Measure the outer diameter of the rotor shaft and the diameter of the housing hole and calculate the difference between the hole diameter and shaft diameter.

Compare the obtained measuring results with the standard values given below:

Nominal play:	0.013 – 0.043 mm
Play at wear limit:	0.2 mm

> If the results of the play measurements described in points 1, 2, 3 and 4 exceed the wear limit value, the affected parts must be replaced.

Miscellaneous

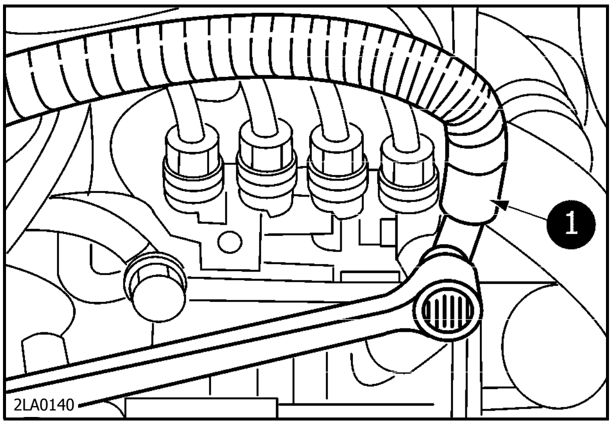
- Check the driving gear of the rotor shaft and replace the entire assembly if it is slackened or turns in a misaligned way.
- Push the plunger of the oil pressure governor valve through the housing hole and replace the entire assembly if the plunger fails to return owing to a broken spring, etc. (Only for engines equipped with oil heat exchanger).
- Check that the rotor shaft turns in a smooth and regular way when the driving gear is operated.

YANMAR INJECTION PUMP

How to bleed air from the fuel circuit

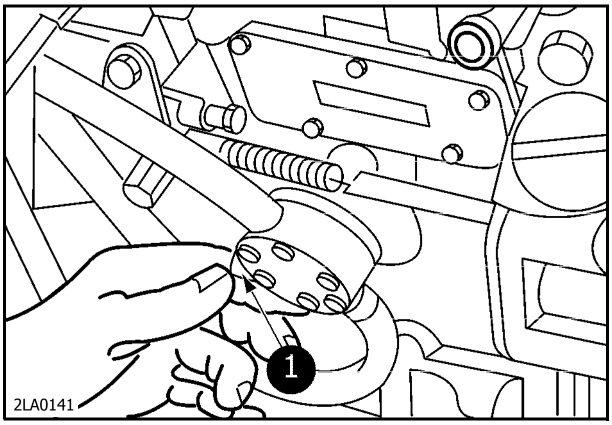
> **DANGER**
> Do not use matches, cigarette lighters or torches as a light source on the machine since it contains inflammable fluids.

1. Disconnect the fuel return hose (1) from the injection pump.



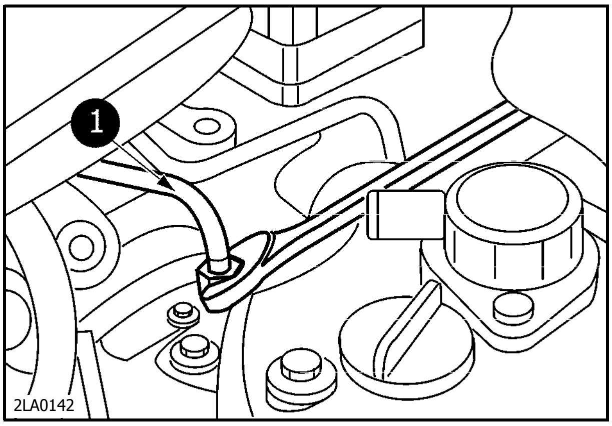
142

2. Fill the system by operating the lever (1) on the pump casing by hand.
   Make sure that fuel flows from the pump return.



143

3. Disconnect the fuel hose (1) from one of the injectors, operating as indicated in the figure.



144

4. Operate the starter motor and make sure that the jet of fuel from the injector is adequate and constant.
5. Connect the fix the hose (1).
6. Connect and fix the fuel return hose (1, fig. 142).

INJECTION PUMP - OVERHAUL

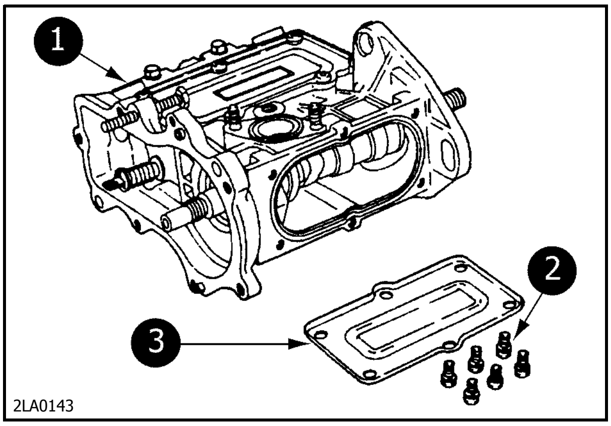
Demounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

1. Unscrew the fix fixing screws (2) and remove the lower cover (3) of the injection pump (1) to drain the lubricating oil from it.

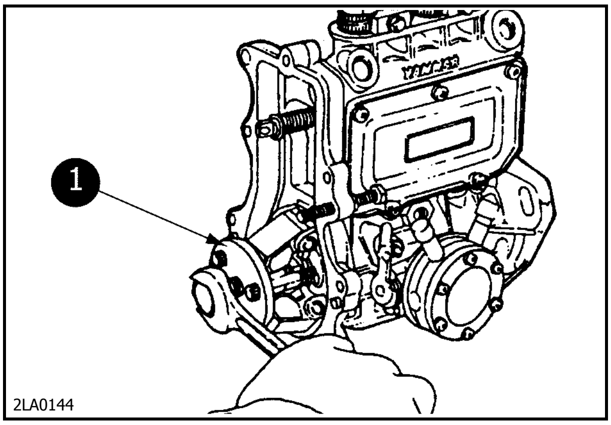
2. Overturn the injection pump to drain off the diesel fuel.



145

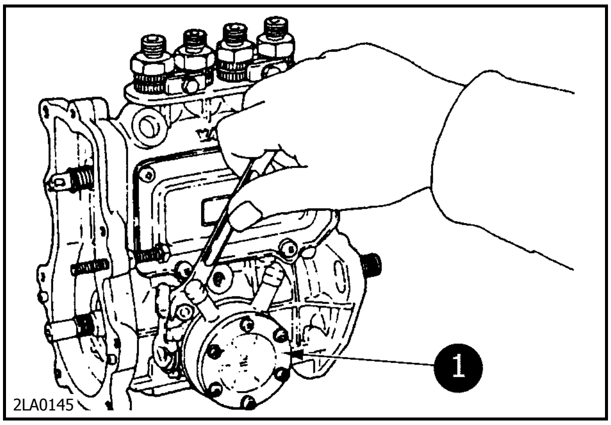
3. Operating as indicated in the figure, remove the centrifugal weights from the regulator using the puller (1) **008 MT MIS** (mod. MISTRAL AMERICA 40) or **009 MT MIS** (models MISTRAL AMERICA 45 and 50) (1).

> To separate the regulator unit from the injection pump, see page 110.



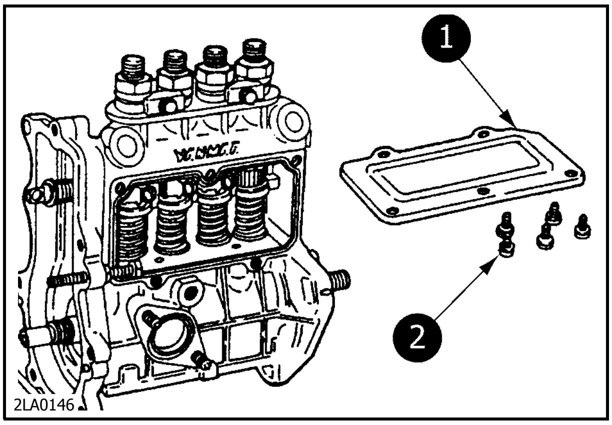
146

4. Remove the fuel pump (1) by loosening the fixing nuts, as shown in the figure.



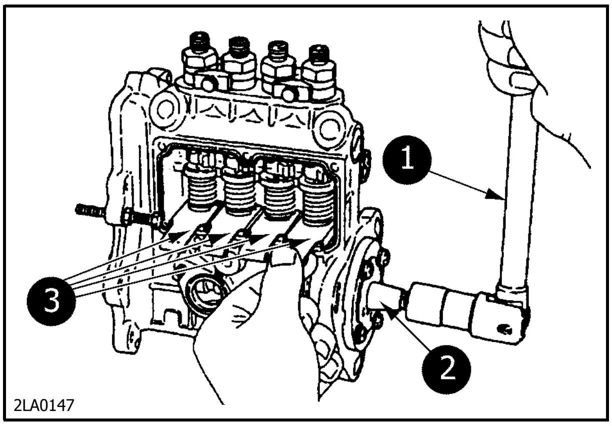
147

5. Unscrew the five fixing screws (2) and remove the side cover (1) from the injection pump.



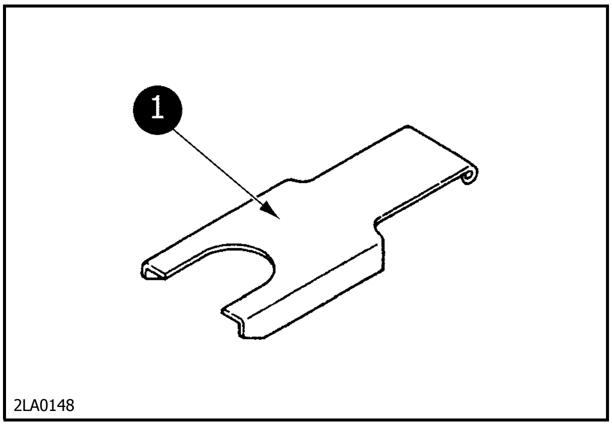
148

6. Using a wrench (1) as shown in the figure, turn the camshaft (2) of the injection pump while allowing the plunger guide to cover its maximum travel. Fit the tappet bearing bracket **010 MT MIS** (3) between the lower plunger spring retainer and the pump casing. Do this for each plunger.



149

The specific tool **010 MT MIS** is shown in the figure on the right.

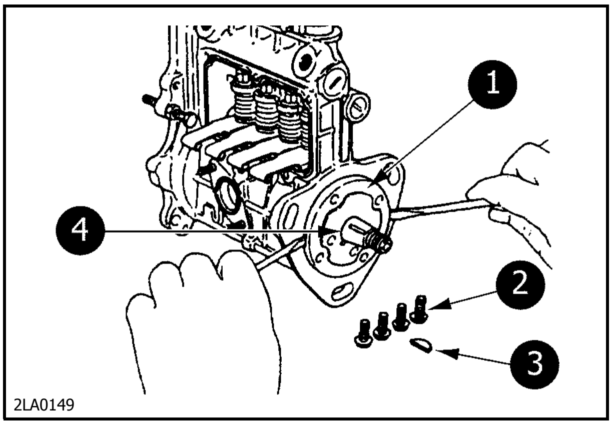


150

7. Remove the tab (3) from the camshaft (4) of the injection pump.

8. Remove the bearing of the injection pump camshaft in a horizontal direction, inserting a screwdriver into each of the two grooves in the surface on which the bearing support (1) is mounted.

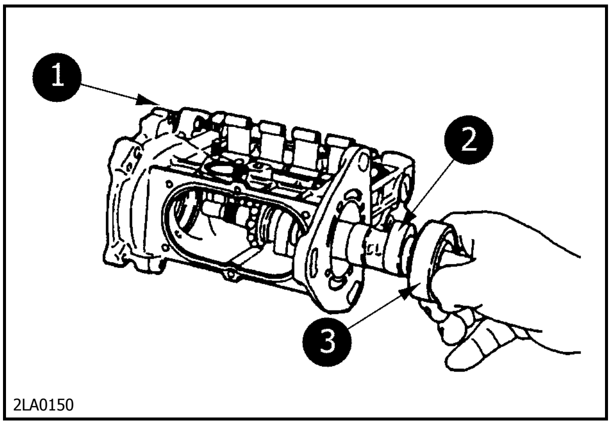
1. Make sure that the thread of the injection pump camshaft does not damage the seal.
2. Do not lose the adjuster seals and the seal between the pump casing and bearing support..



151

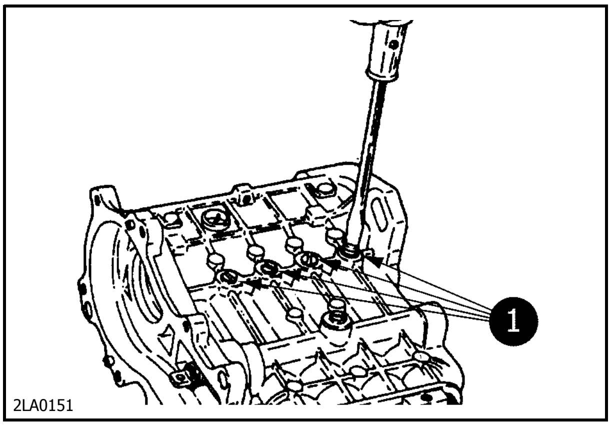
9. Overturn the injection pump (1). Move all the plunger guides towards this latter, then rest the injection pump on one side. Turn the camshaft (2) of the injection pump until the cam of each cylinder touches the outer roller of the plunger guide.

10. Place a plate against the camshaft end, on the governor side. Tap on the plate and take out the two bearings (3) of the camshaft and transmission.



152

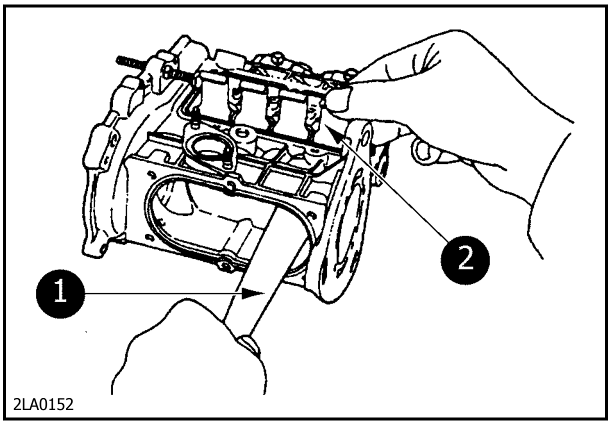
11. Remove the plunger guide retainers (1) using a screwdriver, as shown in the figure.



153

12. Working as shown in the figure, and using the handle of a hammer or a similar object, push the plunger-guide upwards from the bottom of the pump and take out the tappet (2) tool **010 MT MIS**.

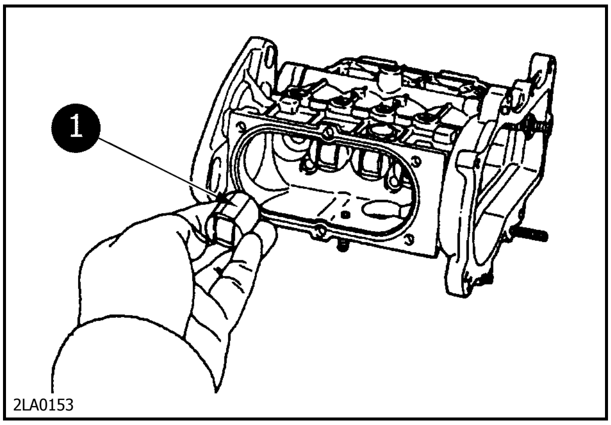
> Take out the tappet (2) tool **010 MT MIS** with the greatest care. Make sure that the plunger guide, plunger, etc., do not suddenly spring out. The plunger spring has sufficient power to push the plunger out.



154

13. Remove the plunger-guide assembly (1).

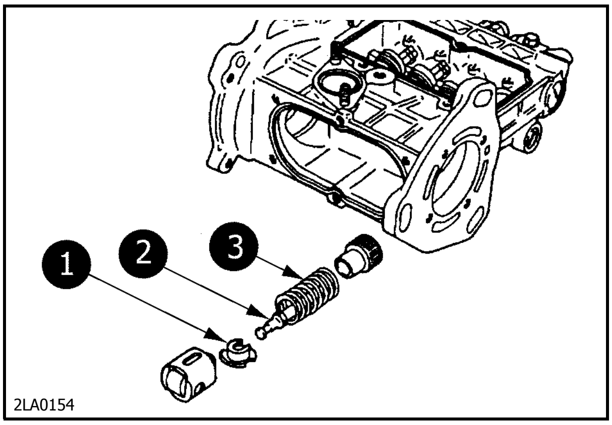
> Avoid holding the pump in a vertical position if possible, as the plunger guide assembly could drop to the ground. Rest the pump on one side when the plunger-guide assembly is being removed.



155

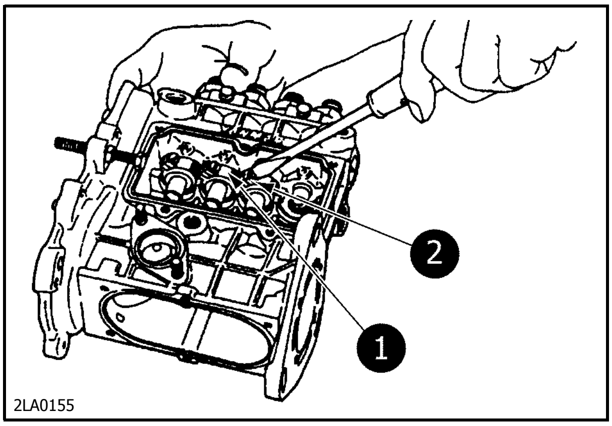
14. Take out the plunger (2), the spring (3) and the lower retainer (1) of the spring from the lower part of the injection pump.

> Separate these parts for each cylinder.



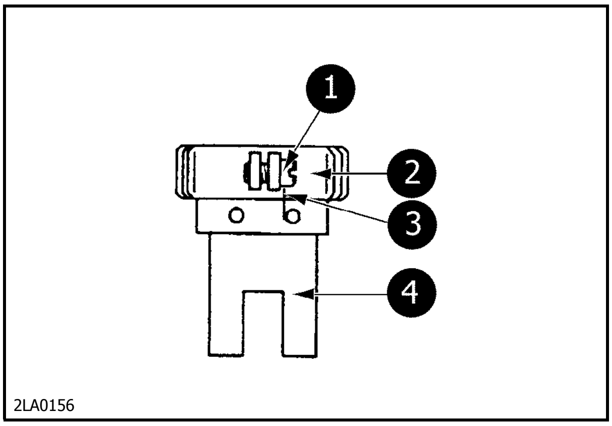
156

15. Using a screwdriver, remove the retainer screw (2) from the fuel governor pinion (1), as shown in the figure.



157

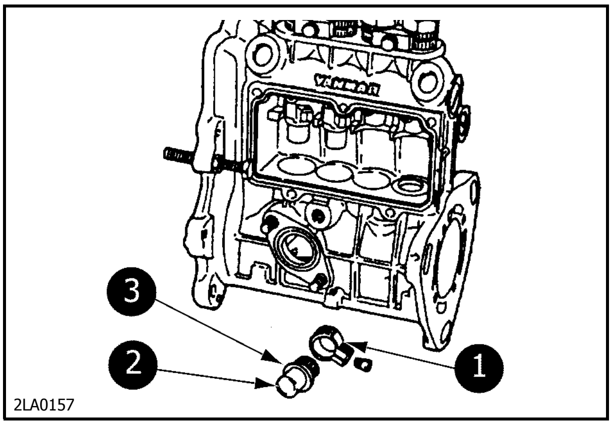
> 1. Loosen the governor pinion (2) retainer screw (1) to allow the part to be removed from the adjuster sleeve (4). Before loosening it, make sure that the matching mark (3) on the pinion is aligned with the one on the sleeve. Make other marks if the mark is poorly visible or not aligned. These marks will be useful during the successive injection timing phase.
> 2. Separate all these parts for each cylinder.



158

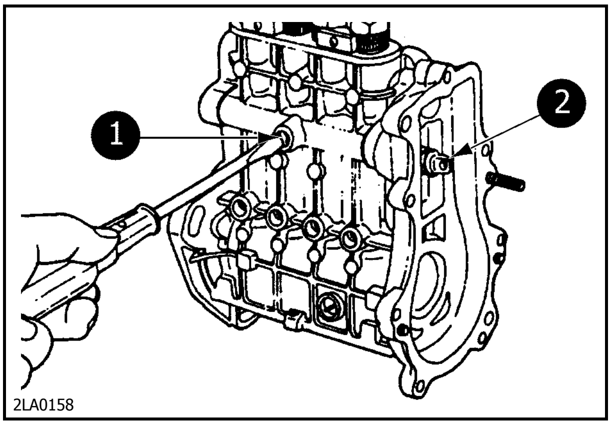
16. Remove the adjuster pinion (1), the sleeve (2) and the upper retainer (3) of the plunger spring.

> Separate these parts for each cylinder.



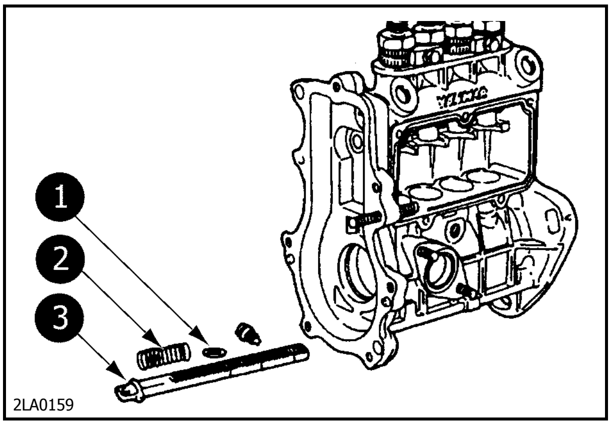
159

17. Remove the retainer (1) of the adjuster rack (2) and take this out, using a screwdriver, as shown in the figure.



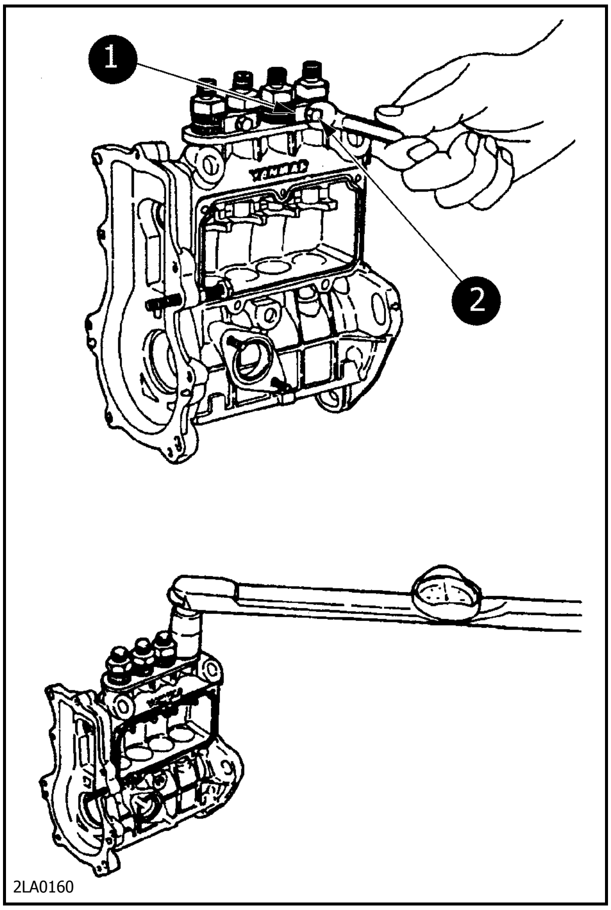
160

> Make sure that the spring (2) and spacer (1) on the rack (3) are not lost.



161

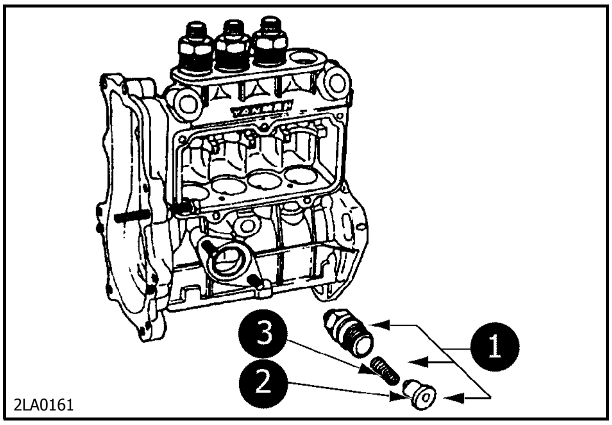
18. Slacken off the bolt (2) of the retainer (1) of the delivery valve holder and remove it.



162

19. Remove the delivery valve assembly (1).

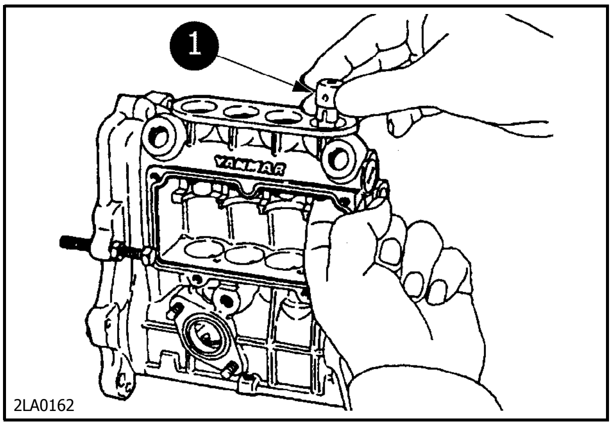
> **1.** Take care to avoid losing the small parts, such as the seal, the spring (3) and the delivery valve pad (2).
>
> **2.** Carefully separate the delivery valve assembly of each cylinder.



163

20. Tyake out the plunger cylinder (1), allowing it to pass through the upper part of the injection pump.

> Leave the cylinder and plunger together.



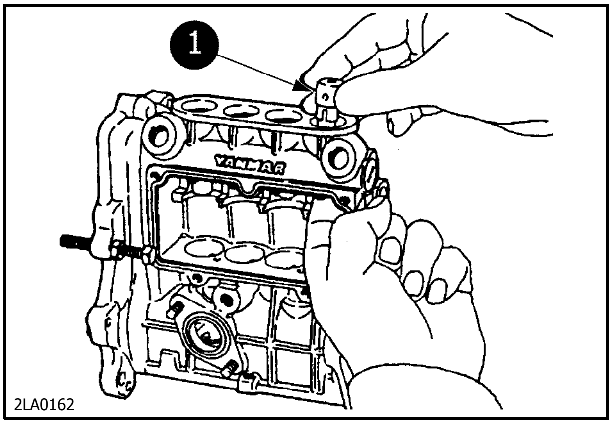
164

Assembly

> **WARNING**
>
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

1. Fit the plunger cylinder (1) back into the injection pump, from the upper part.

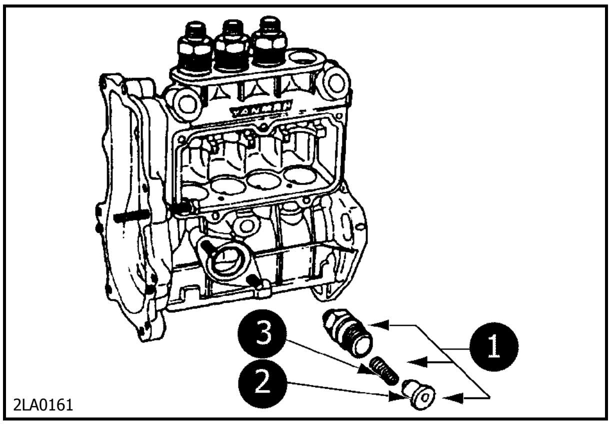
> Make sure that the retainer of the plunger cylinder is correctly mounted in its housing with a key.



165

2. Insert the delivery valve assembly (1), the spring (3) and the valve retainer through the upper part of the injection pump as shown in the figure.

> Replace the seal and retention ring of the delivery valve before re-assembling the injection pump.

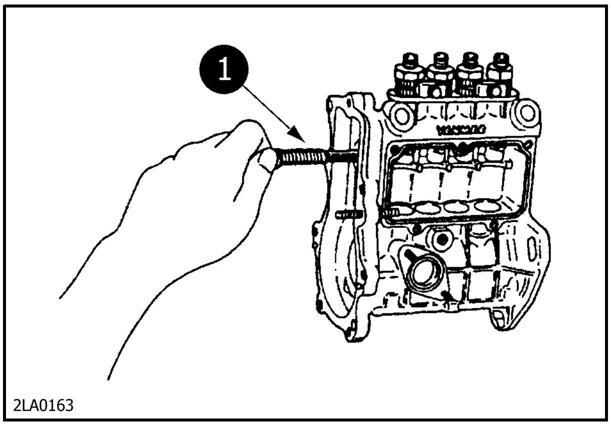


166

3. Insert the rack (1) and tighten the relative retainer.

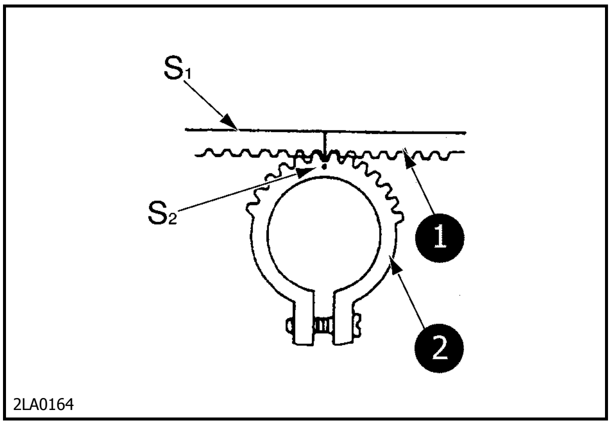
> 1. Make sure that the rack spring has been mounted.
> 2. Make sure that the rack travel is regular.

4. Insert the rack locking screw into the threaded hole of the retainer.



167

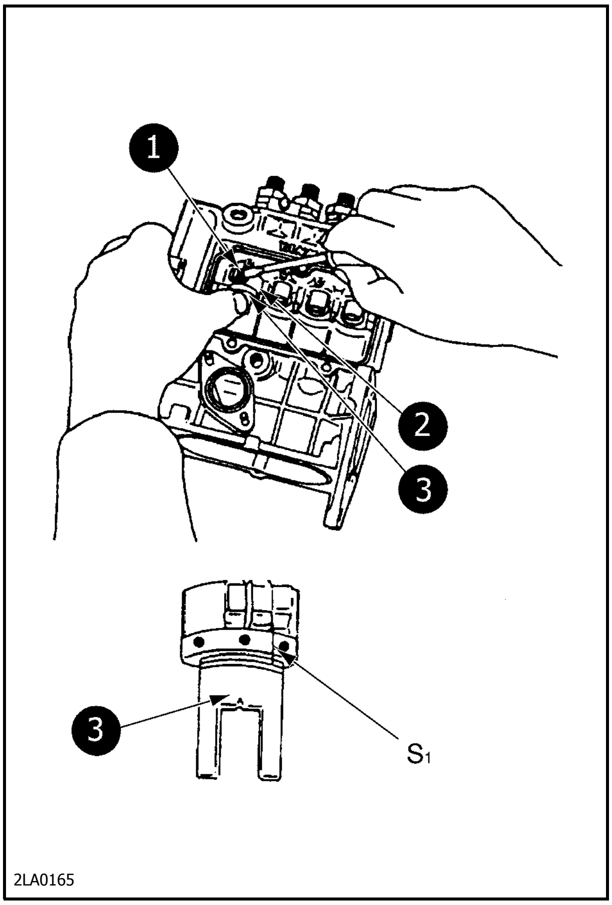
5. Look at the injection pump from the bottom and align matching mark S_1 on the rack (1) with the S_2 mark on the pinion (2).



168

6. Holding the pinion (2) with one hand so that the matching mark is kept in the right position, fit on the sleeve (3) and slightly tighten the pinion retainer screw (1).

> Fit the sleeve so that the holes in its surface point towards the retainer screw. Meanwhile, align matching mark (S_1) of the sleeve (3) with that of the pinion.

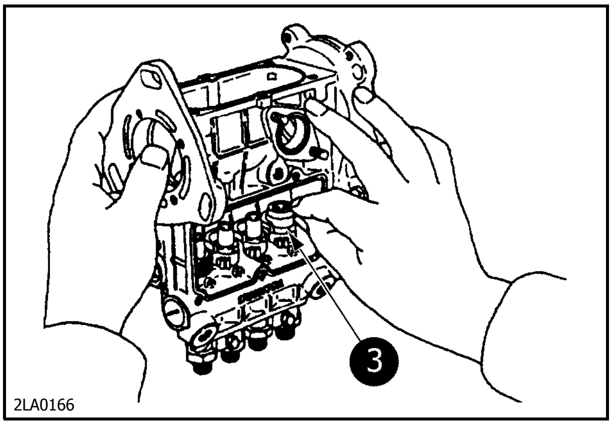


169

7. Mount the upper retainer (1) of the plunger spring.

> 1. Mount the upper retainer (1) of the plunger spring.
> 2. Check again to make sure that the rack moves in the correct way.

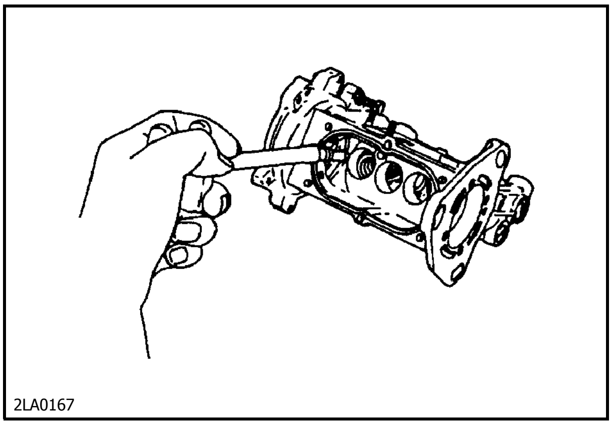
8. Mount the plunger spring.



170

9. Mount the lower retainer of the plunger spring on the top part of the plunger itself. Align the matching mark on the plunger side with the one on the adjuster sleeve and insert the plunger from the bottom of the injection pump using tool **011 MT MIS**.

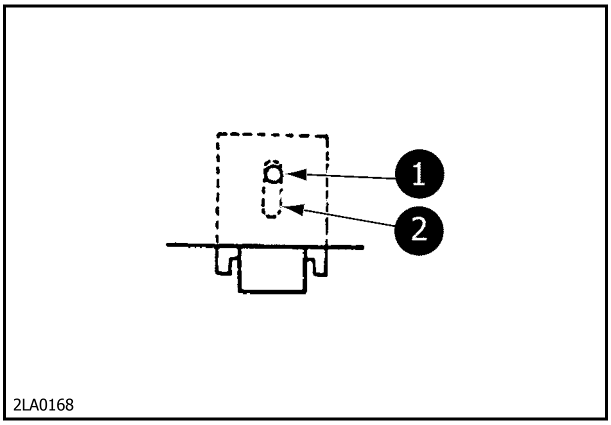
> Do not mount the plunger in reverse, otherwise the injection volume would increase in an excessive way until it became uncontrollable.



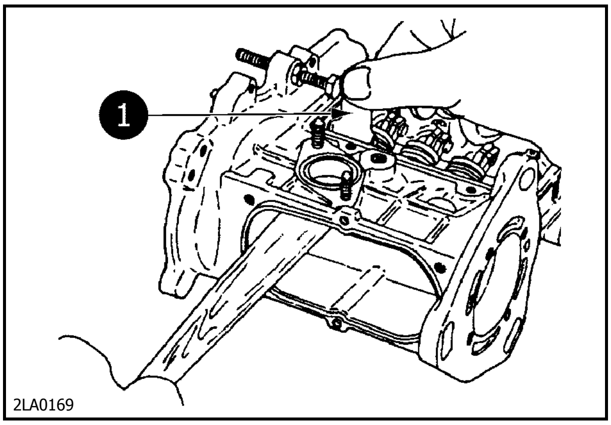
171

10. Insert the plunger guide assembly at the bottom of the injection pump. Push the plunger guide upwards with the handle of a hammer or some similar tool, then insert tappet bearing tool **010 MT MIS** (1, fig. 173) between the lower spring retainer and the body of the injection pump.

> **1.** Keep the retaining groove (2, fig. 172) of the plunger guide pointing upwards and align it with the corresponding hole (1, fig. 172) of the plunger guide retainer screw on the body of the injection pump.
> **2.** Check to make sure that the rack moves freely. If this is not the case, it means that the plunger spring is interfering with some other part. In this case, hold the spring in position with a screwdriver.
> **3.** Insert the normal adjuster ring and tighten it at the same time when the plunger guide assembly is being replaced with a new one.

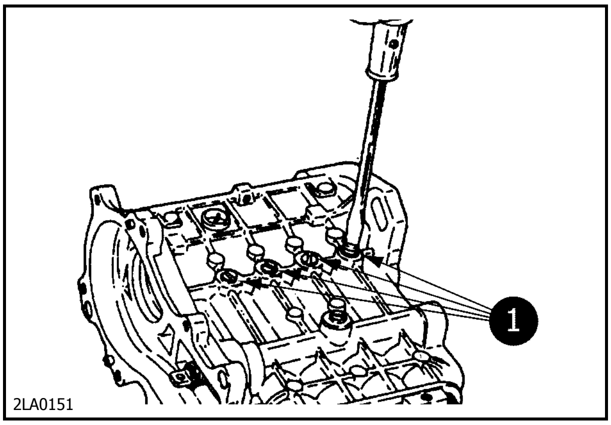


172



173

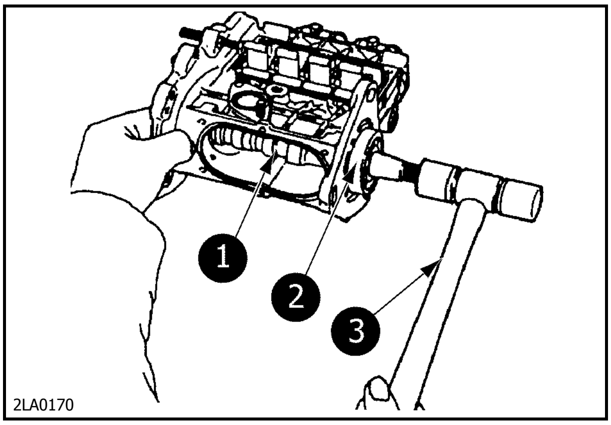
11. Make sure that the retainer groove (2, fig. 172) of the plunger guide is positioned correctly. Tighten the retainer screw (1) of the plunger guide.



174

12. Position the bearings (2) on both ends of the camshaft (1). Insert them by tapping them lightly from the transmission side.

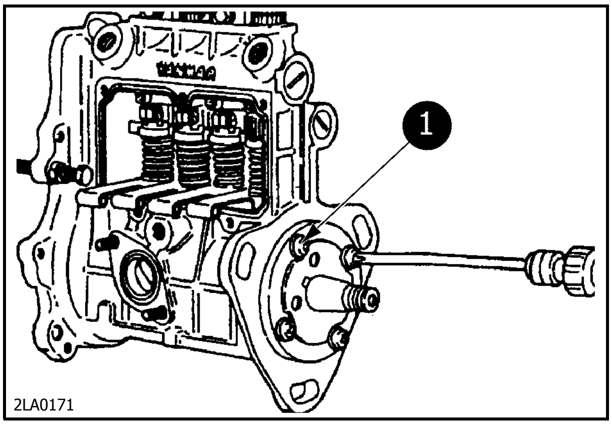
> Overturn the injection pump. Move the plunger guide towards the spring and fit the camshaft into the injection pump.



175

13. Mount the retainer seal in the inner part of the bearing holder. Mount the bearing holder (1).

> Before assembling, spread the camshaft and the retainer seal with oil to prevent them from being damaged.



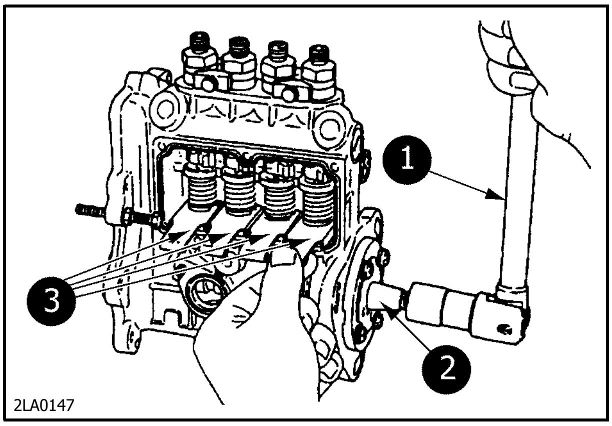
176

14. Fit the tab into the camshaft.

15. Using a wrench (1) as indicated in the figure, turn the camshaft (2) and remove the tappet bearing tools **010 MT MIS** (3).

16. Fix the injection pump on to a support. Using a plastic hammer (5, fig. 175) tap in the end of the camshaft and measure the float with tool **012 MT MIS**.

Camshaft float (all models) . . . . (mm)	0.02 – 0.05

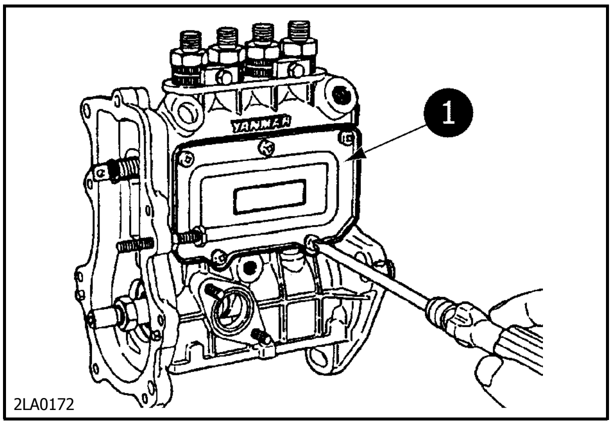


177

Adjustment procedure

Remove the adjuster seal if the float is less.
Add one or more adjuster seals if the float is more.
Thickness of the adjuster seal: 0.5; 0.4; 0.3 and 0.15 mm.

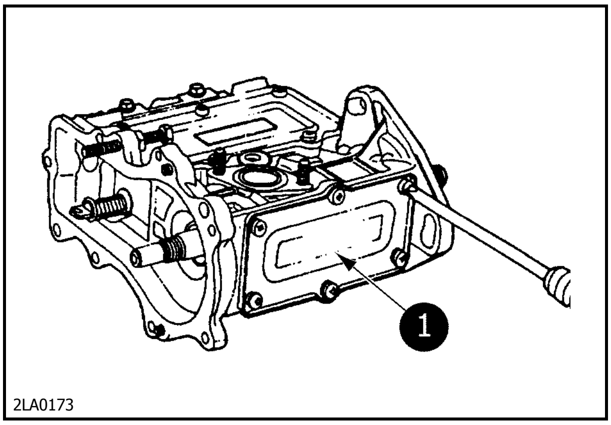
17. Mount the side cover (1) of the injection pump.



178

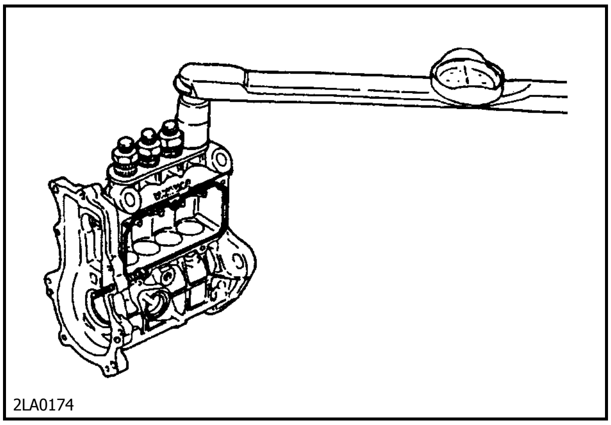
18. Mount the side cover (1) of the injection pump.

19. Tighten the spring holder of the delivery valve to a 34.3 – 39.2 Nm torque value.



179

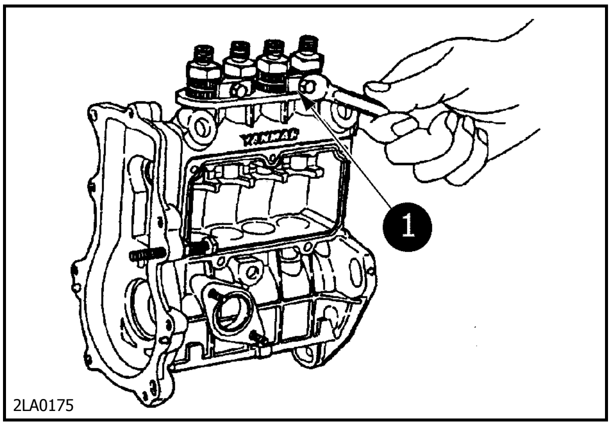
> **1.** Tighten the spring holder of the delivery valve by hand as much as possible. If the bolt becomes difficult to turn halfway through the operation, the seal or the delivery valve could have slipped out of position. Remove, adjust and tighten again.
>
> **2.** Do not tighten the valve holder too much. Excessive tightening could cause the rack to operate incorrectly.



180

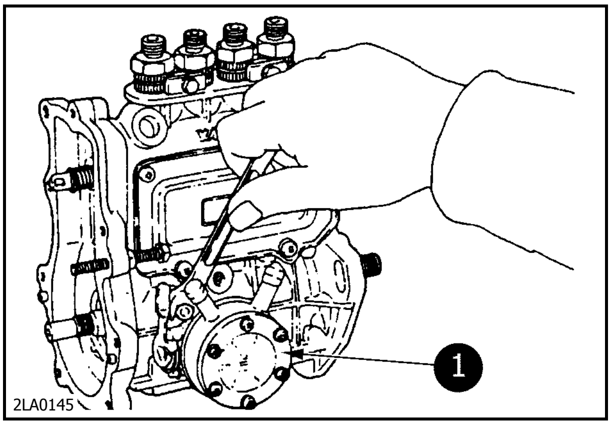
20. Tighten the valve holder retainer stop (1) to a 2.9 Nm torque value.

> Do not tighten the valve holder too much as oil leaks could ensue.



181

21. Mount the fuel pump.



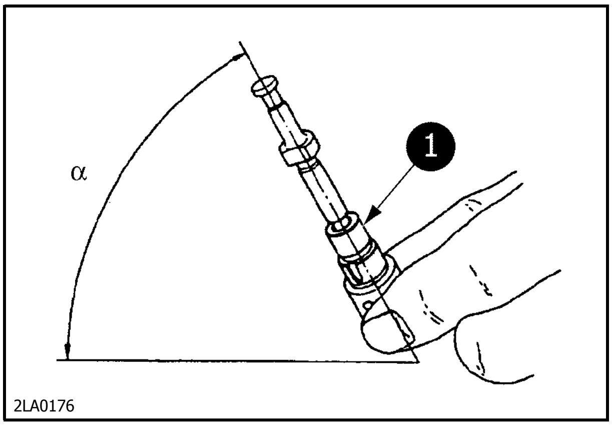
182

Thoroughly clean the parts before checking them. Take care to prevent the sliding surfaces of the plunger, the delivery valve and the other components from being damaged.

Do not use solvents to clean the parts. Use cleaning products that comply with the standards in force.

Plunger inspection

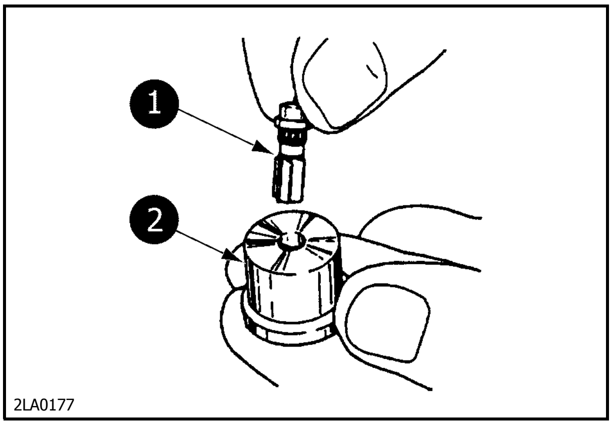
1. Thoroughly clean the plunger (1). Replace the plunger if its guide groove is scratched or discoloured.
2. To test the plunger, tilt the plunger cylinder (1) at an α angle of about 60° and check to make sure that it slides backwards without friction. If it does, the plunger can be considered efficient. Turn the plunger and repeat the test several times. If the plunger's reverse travel is too fast (or too slow), or if it stops half way, repair it or replace the complete assembly.



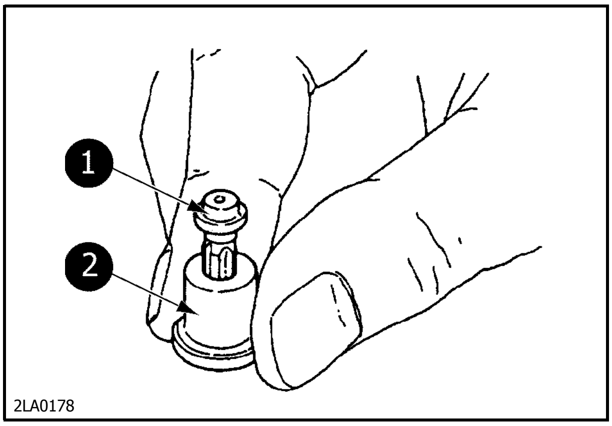
183

Delivery valve inspection

1. Replace the complete valve if the suction-thrust plate or the delivery valve housing are scratched, notched, worn or damage.
2. Plug the hole at the bottom of the delivery valve holder (2) with a finger and maintain the housing unchanged. Fit the delivery valve (1) into the valve holder. Remove the finger and check to make sure that the valve trips backwards. If it does, it is efficient, failing this it must be replaced.



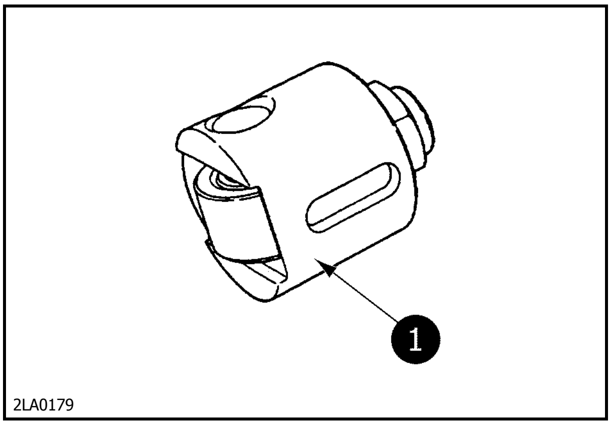
184



185

Plunger guide, plunger cylinder inspection

1. Check to make sure that the sliding surfaces of the plunger guide (1) are not worn too much.
2. Check whether the plunger cylinder housing shows signs of irregular contact, burrs, traces of gas leaks or other defects. If necessary repair or replace the cylinder, otherwise the circulating lubricating oil will dilute.
3. If the surface of the outer roller of the plunger guide is worn or defective, it must be replaced.
4. If the circumference of the plunger guide and the hole of the pin on the roller are worn or defective, they must be replaced.
5. Replace the whole assembly if the plunger guide unit, the pin and roller are wavy.

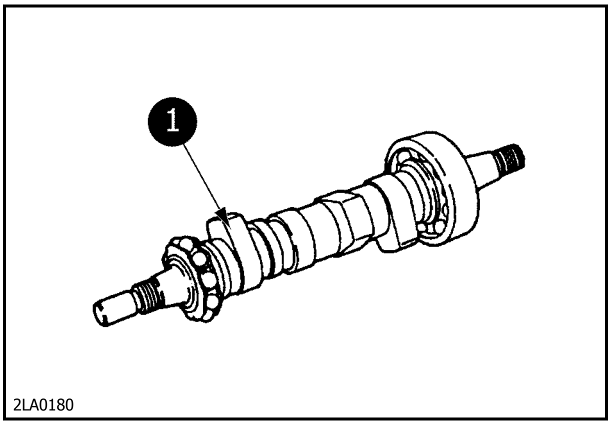


186

Camshaft and bearing inspection

1. **Camshaft**
   Check whether the surface of the camshaft (1) shows signs of damage or wear and whether the spline housing and the threads on both sides are warped. Replace the camshaft if this is the case
2. **Bearing**
   Replace the bearing if the surface of the tapered roller and outer ring are damaged or worn.

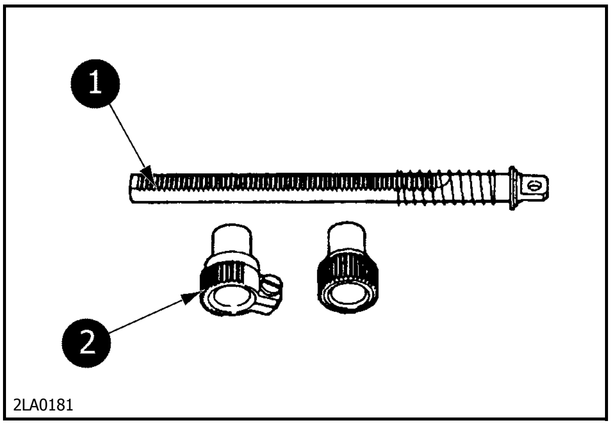
> The bearing must also be replaced whenever the camshaft of the injection pump is replaced.



187

Fuel regulating pinion and rack inspection

1. Make sure that the rack (1) is not warped, worn or bent in the point where the pinion meshes (2).



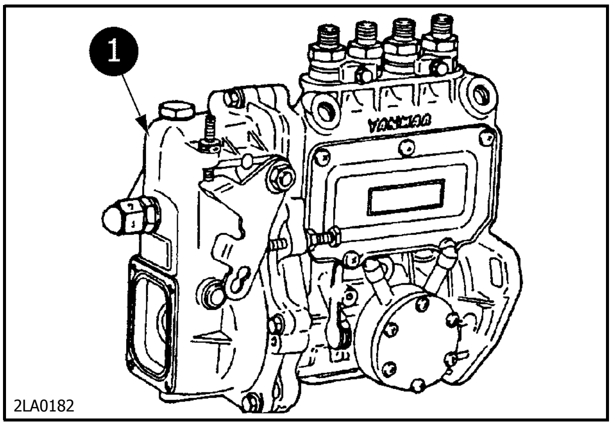
188

REGULATOR UNIT - OVERHAUL

Demounting

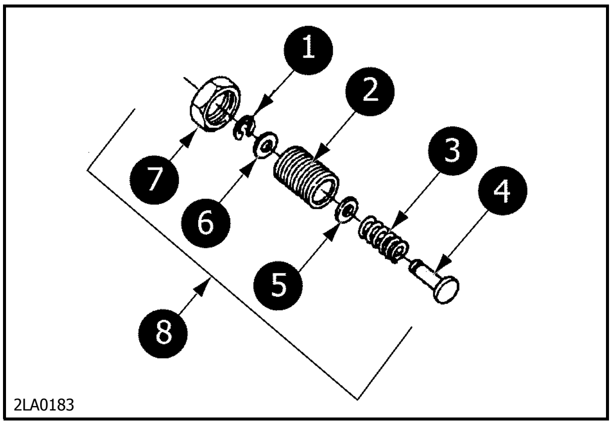
> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

1. Regulator housing removal.



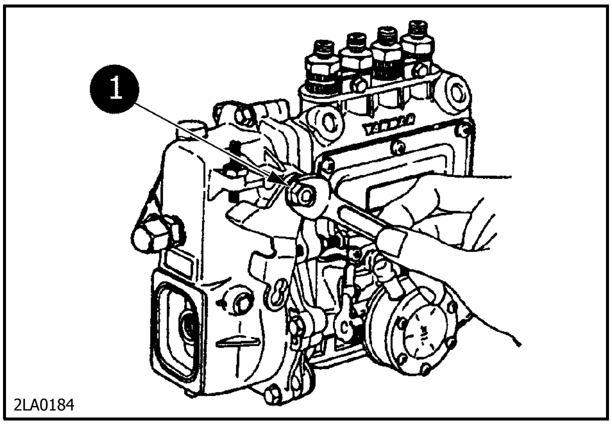
189

> Slacken off the self-locking nut (7) in models equipped with torque regulator spring assembly (8).



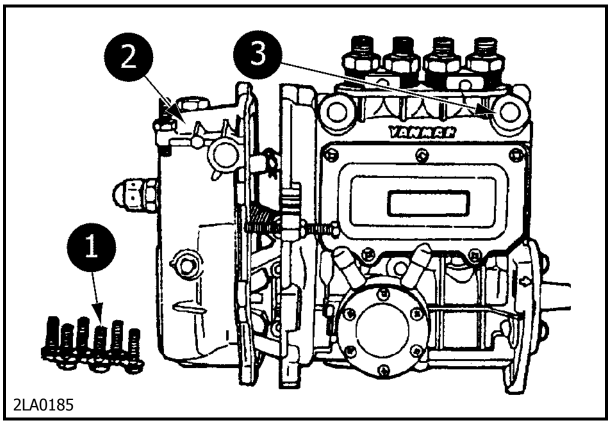
190

2. Remove the hex nut (1) of the control lever and remove the lever from the shaft.



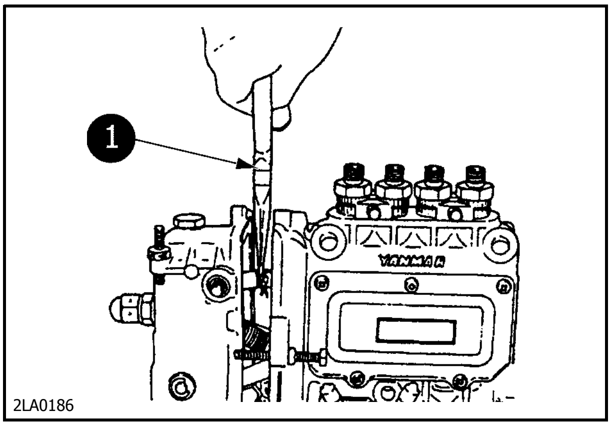
191

3. Unscrew the fixing bolts (1) of the regulator housing (2). Remove the regulator housing from the injection pump (3) by lightly tapping on the housing with a plastic mallet. Create a gap between the regulator housing and the injection pump, moving only the mobile parts of the regulator lever.



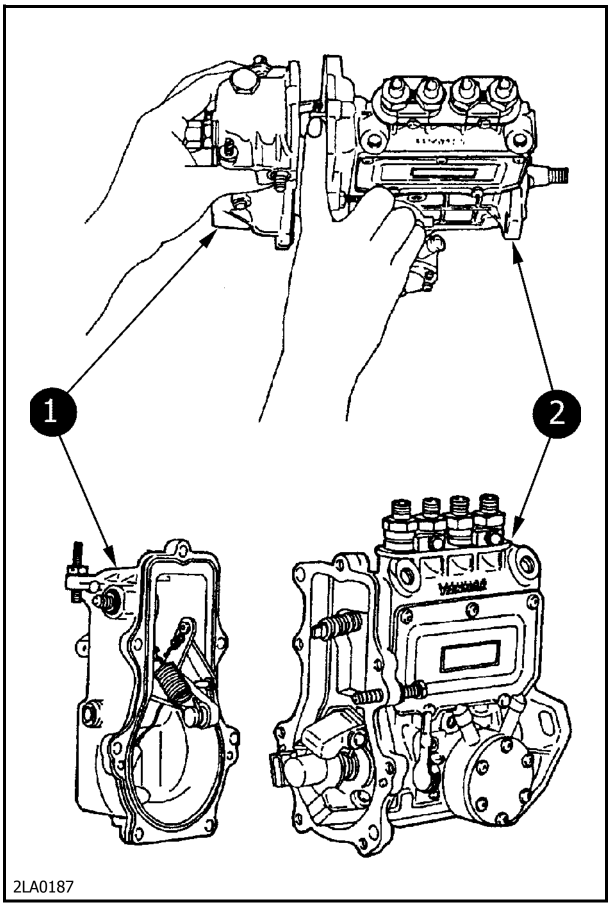
192

4. Push out the elastic fork of the regulator connection, inserting a suitable pair of pliers (1) between the injection pump and the regulator housing.



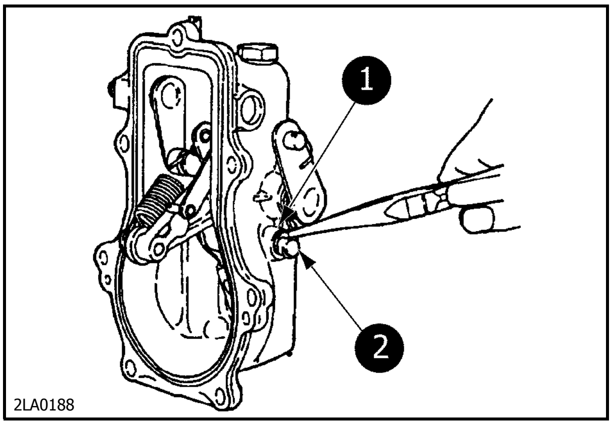
193

5. Separate the regulator (1) from the injection pump (2), detaching it from the regulator housing and injection pump, pushing the elastic fork away from the connection bracket of the regulator with the rack.



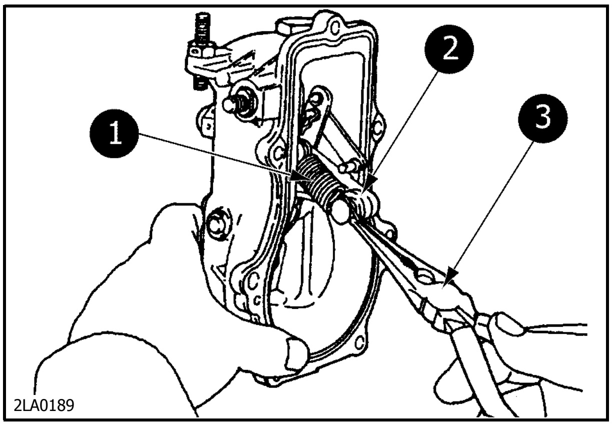
194

6. Remove the return spring of the stop lever (1) from the lever shaft (2).



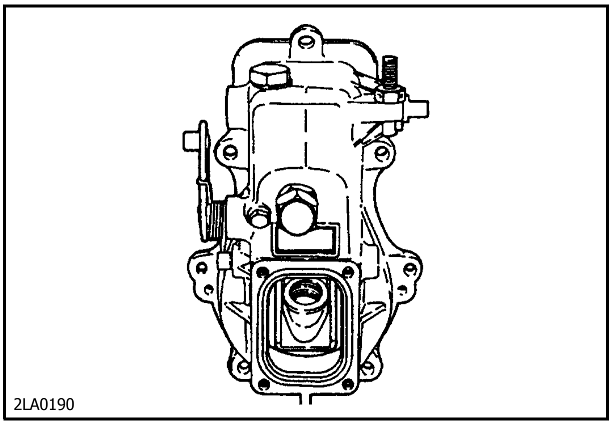
195

7. Using an adequate pair of pliers (2), release the regulator spring (1) from the tensioning lever (2) and from the control lever shaft.



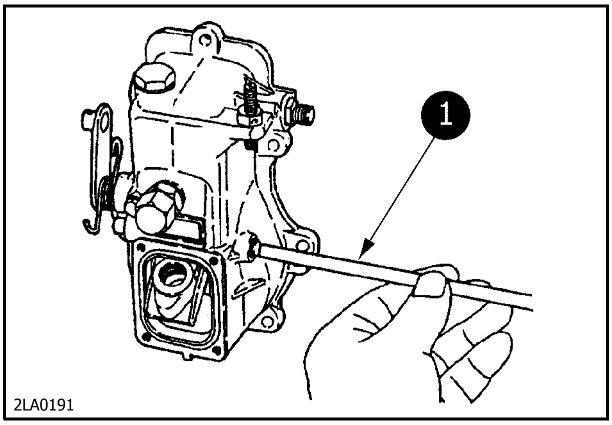
196

8. Remove the retainer of the regulator lever shaft.
Remove the spring ring from both ends of the regulator lever shaft.



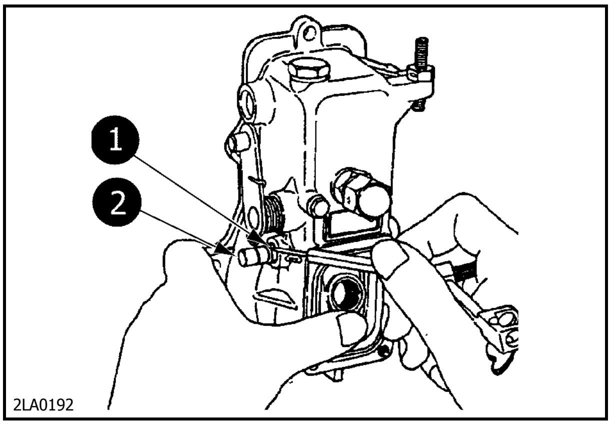
197

9. Insert the rod (1) (diameter 8 mm or less) into one of the ends of the regulator lever shaft and tap on it until the retention ring projects from the opposite side of the regulator housing.



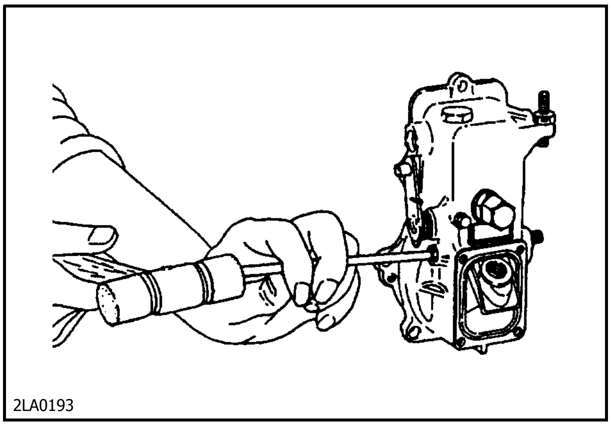
198

10. Remove the O-ring (1) from the shaft (2) of the regulator lever.



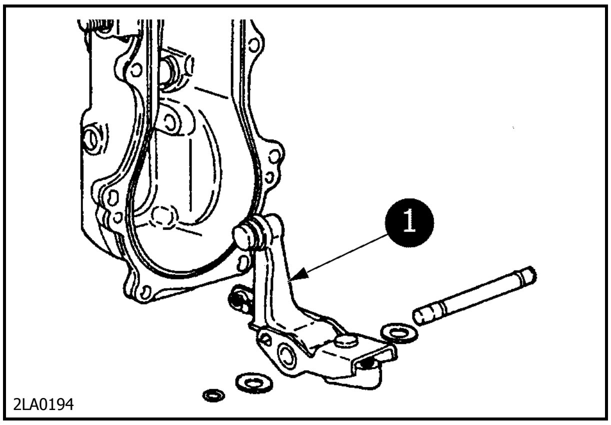
199

- Tap lightly on the end of the shaft and remove it.



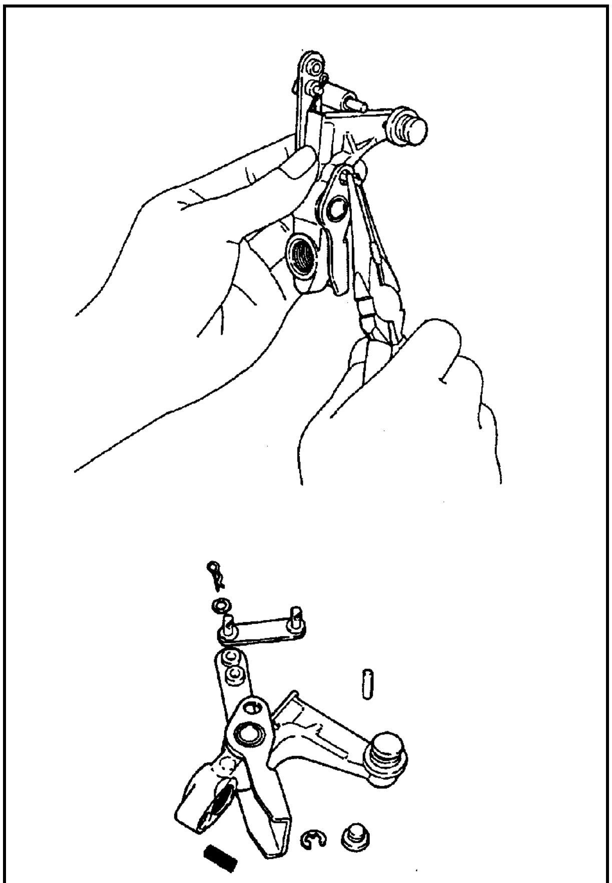
200

11. Remove the bracket (1) that connects the regulator from the lever.



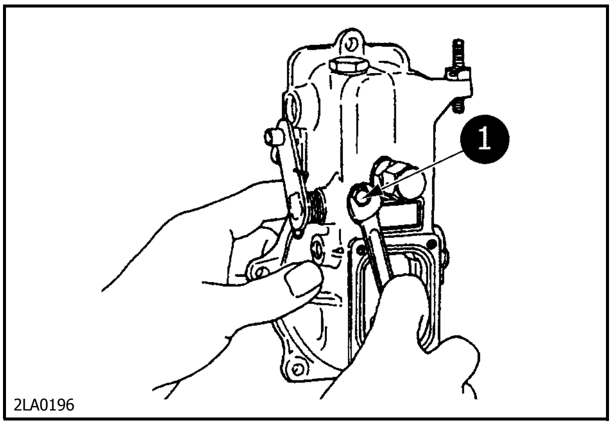
201

The regulator assembly consists of the regulator lever, the tensioning lever and the torque adjuster spring assembly. It normally need not be demounted.


2LA0195

202

12. If necessary, take out the retainer lever, remove the stop pin (1) of the retainer lever shaft and tap lightly inside the regulator housing.

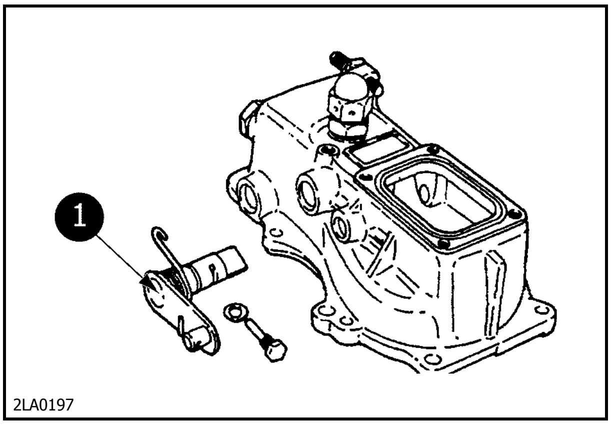


2LA0196

203

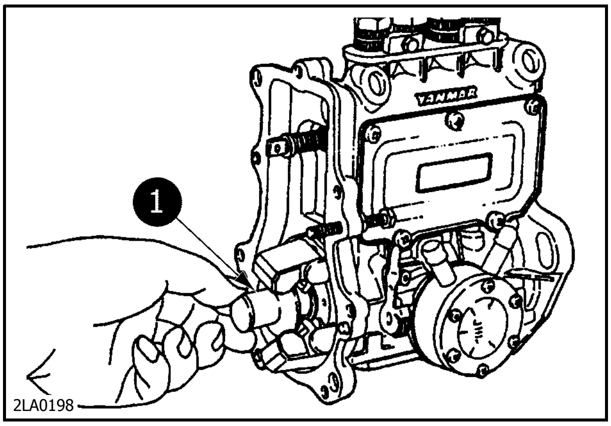
13. If necessary, take out the shaft of the regulator lever (1), tap lightly on the end of the shaft with a plastic mallet and remove the control lever itself.

> **1.** Do not remove limiter unit FO from the regulator housing unless this is strictly necessary.
> **2.** For models with torsion springs, first take out the blank nut, the self-locking nut and then the torsion spring unit.



204

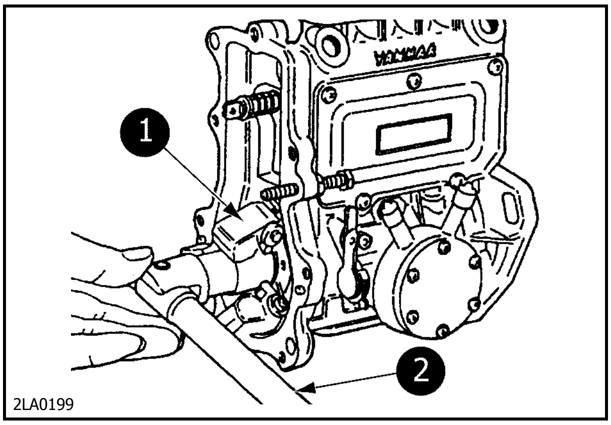
14. Remove the sleeve (1) of the regulator at the end of the injection pump camshaft by hand.



205

15. Fix the bearing support in a clamp in order to hold the camshaft. Loosen the bearing nut of the regulator with a spanner (2) a few turns.

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.
> When the tapered coupling detaches after the nut has been removed, the centrifugal weights of the regulator could spring out.



206

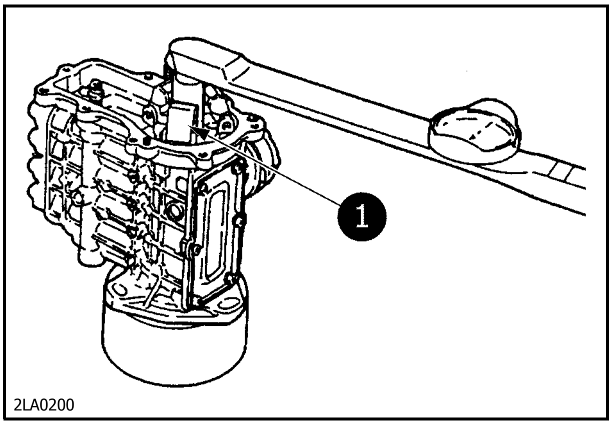
16. Remove the centrifugal weight assembly (1) from the camshaft regulator using puller **008 MT MIS** (mod. MISTRAL AMERICA 40) or **009 MT MIS** (models MISTRAL AMERICA 45 and 50) (1).

Assembly

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Check all parts after they have been demounted and replace them if necessary. Clean all parts and set them in order before re-assembling.
To make sure that the prescribed performances are obtained, check that the assembly has been correctly adjusted after the re-assembly operations.

1. Fix the bearing support in a vice to hold the camshaft of the injection pump in place. Fit the centrifugal weight unit (1) of the regulator into the tapering part at the end of the camshaft. Mount the washer and tighten the nut that supports the centrifugal weights of the regulator to a 44.1 – 49.1 Nm torque value.

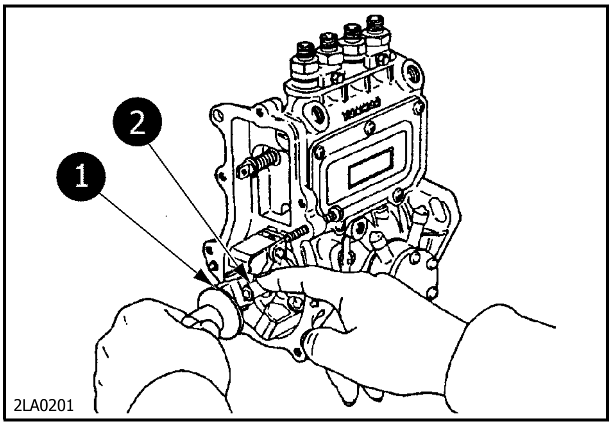


2LA0200

207

2. Open the centrifugal weight unit (1) of the regulator outwards and insert the sleeve (2) on to the end of the camshaft.

> Make sure that the sleeve is free to move after it has been inserted.



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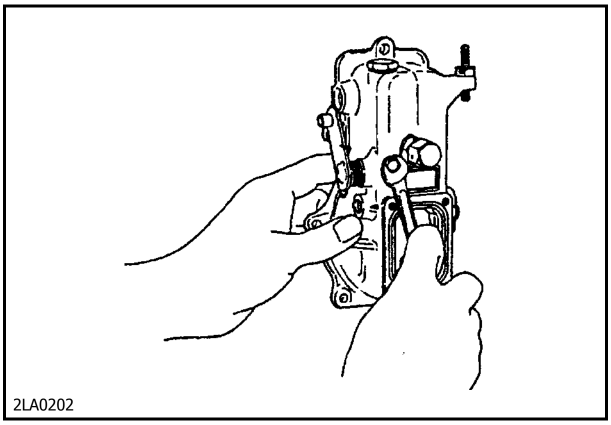
208

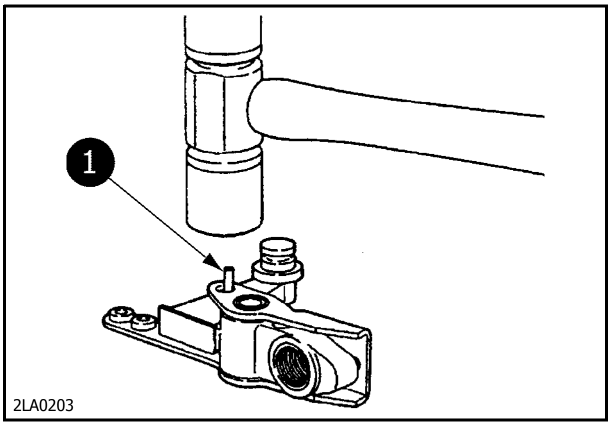
3. After having demounted the retainer lever, mount the return spring on the lever itself, tap the lever lightly with a plastic mallet in order to bed it and then tighten the stop pin.



209

4. After having removed the control lever shaft, insert the shaft and washer inside the regulator housing using an appropriate tool.

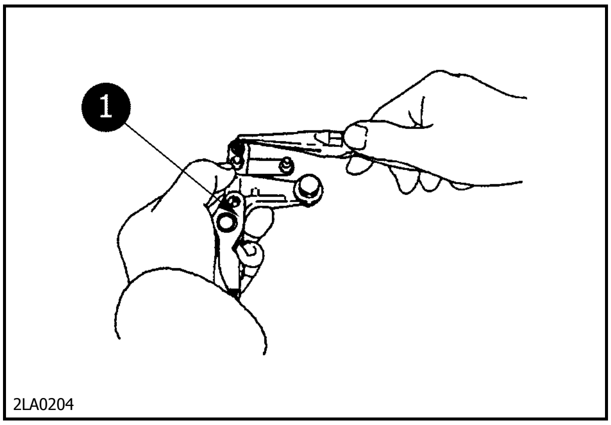
5. If the regulator has been demounted, insert the spring pin (1) by tapping it lightly.



210

6. Mount the regulator lever assembly (1) on to its connection bracket.

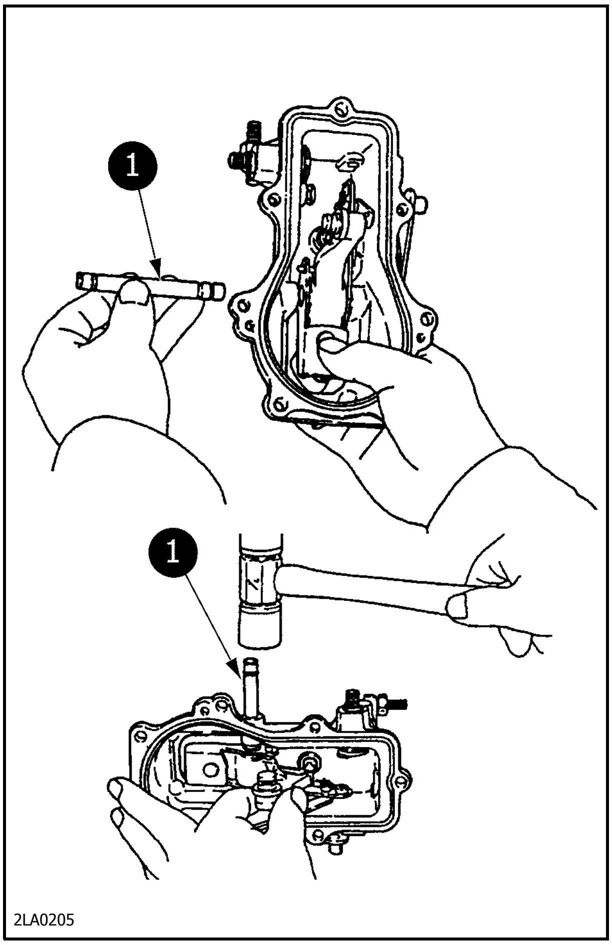
- Make sure that the fixing holes of the regulator connecting bracket are the right ones and that the regulator is fitted in the correct position.
- Check to make sure that the connection bracket of the regulator moves freely.



211

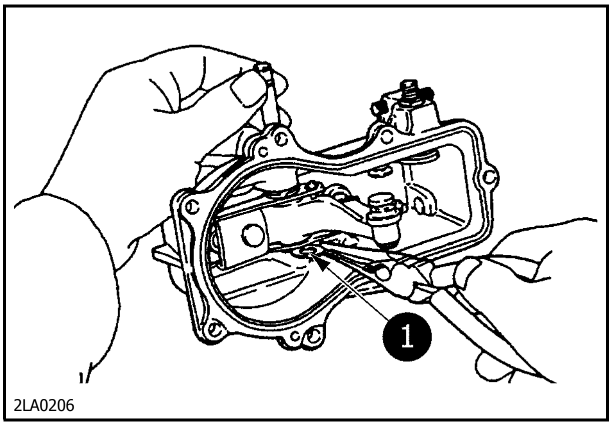
7. Insert the regulator lever shaft (1) assembly into the regulator housing and tap it lightly until the retention ring groove projects from the opposite side of the housing.

- First mount the retention ring on the side on which it strikes.



212

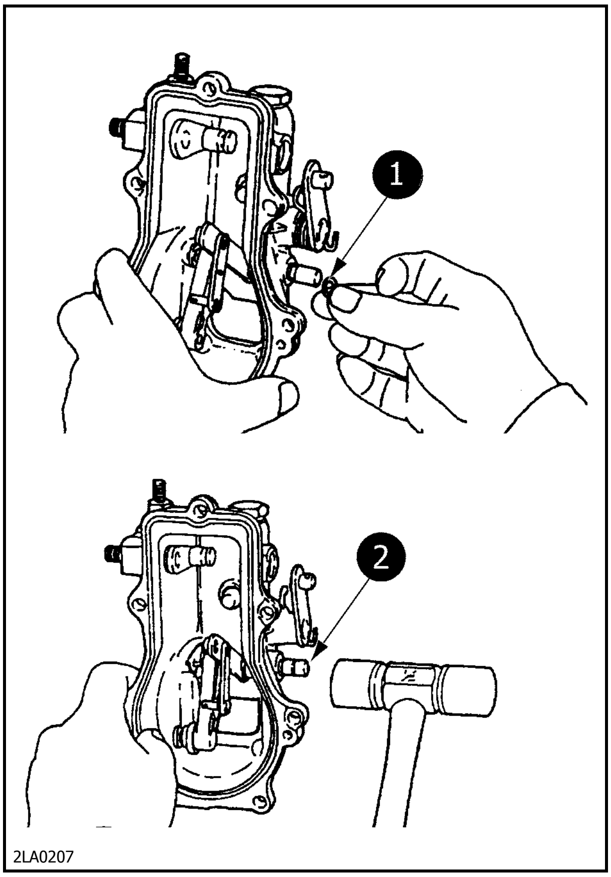
- Remember to mount the washer (1) on both ends of the regulator lever.



213

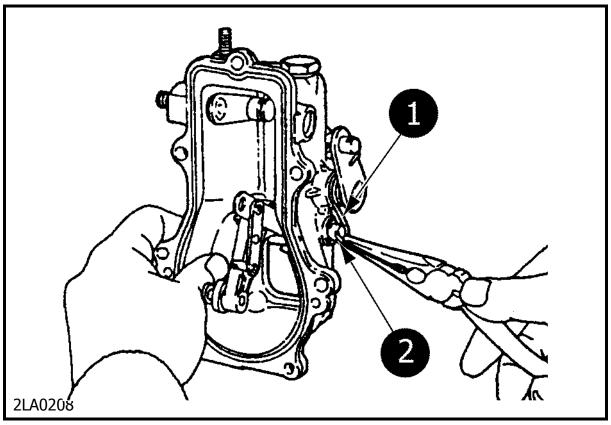
8. After having mounted the retention ring (1), tap on the shaft (2) of the regulator lever in the opposite direction and mount the spring rings into the grooves on both ends.

- After having mounted the regulator lever unit, make sure that its movement is regular.



214

9. Mount the return spring (1) of the retainer lever on the end of the shaft (2) of the governor lever.



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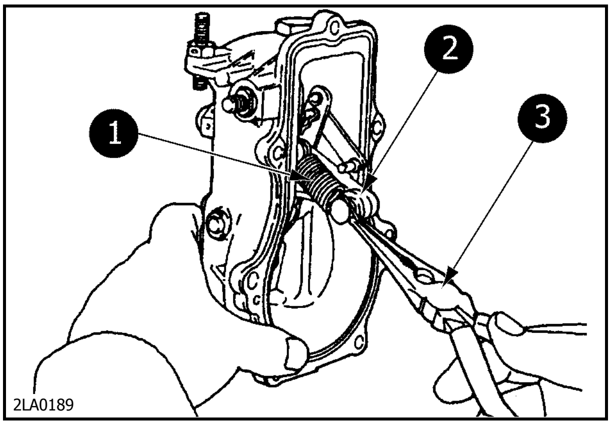
10. Couple the spring (1) of the regulator on to the shaft of the control lever and on to the tensioning one (2) using an appropriate pair of pliers (3).



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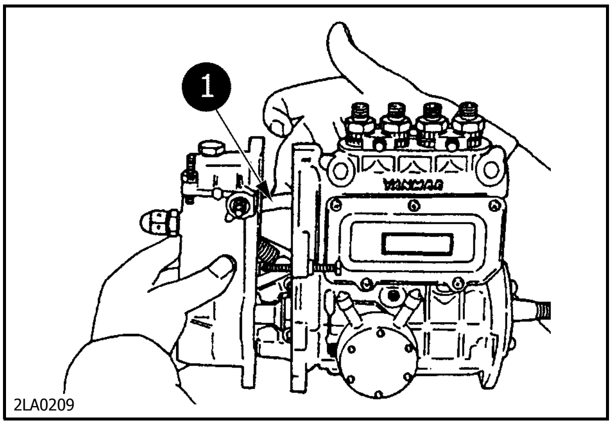
11. Keep the regulator connection adjuster bracket (1) as far as possible from the surface on which the regulator housing is mounted. Insert the pin of the connection bracket into the rack pin hole and mount the spring pin.



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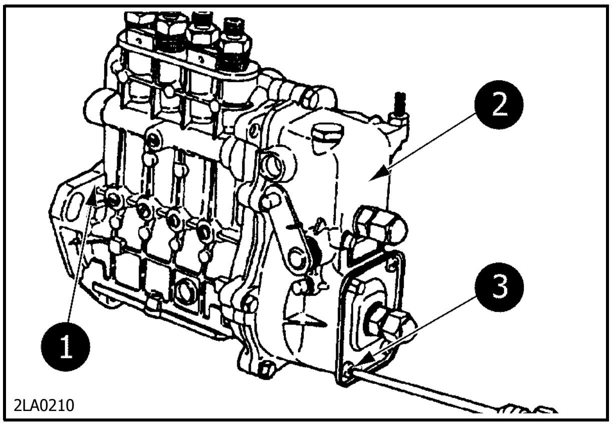
12. Mount the regulator housing (2) on to the injection pump (1) and meanwhile tap lightly on it with a plastic hammer. Tighten the fixing screw (3).

13. Fit on the cover of the regulator housing.
For models equipped with secondary spring for the idling rate, insert the spring and adjuster rod on to the adjuster bolt of the regulator housing cover.



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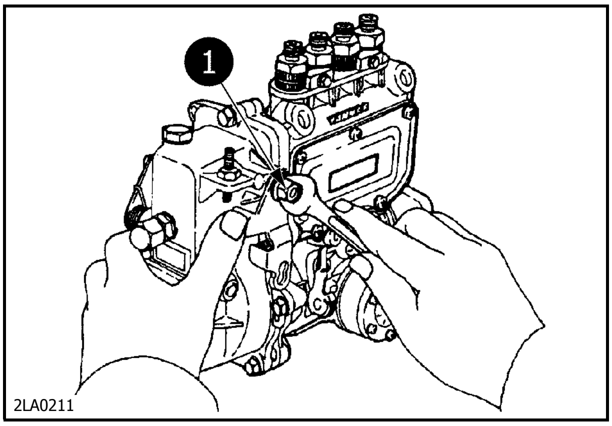
> ☞ Tighten the nut in a temporary way if the torque regulator spring assembly has been removed. The nut must be adequately tightened after the adjustments have been made.

14. Insert the control lever into the corresponding shaft and tighten the nut (1).

> ☞ Move the control lever backwards and forwards to make sure that the movement is regular all along the connection bracket.



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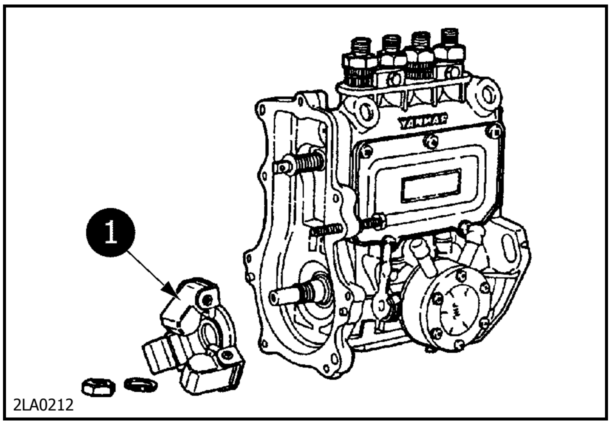
Checking the centrifugal weights of the regulator

Examine the centrifugal weight assembly (1) to make sure that it is in a good condition and functional. It should be replaced in the following cases:

- if the centrifugal weights fail to open or close in a regular way;
- if the surface on which the centrifugal weights contact the sleeve is excessively worn;
- if the centrifugal weight support and pin is worn or the caulking has loosened;
- if the retainer of the centrifugal weight support is excessively worn.



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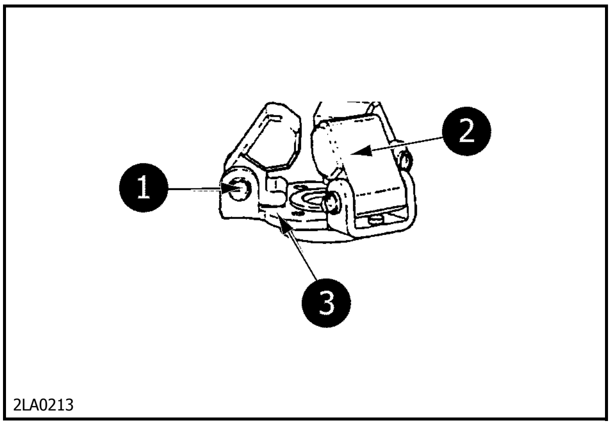

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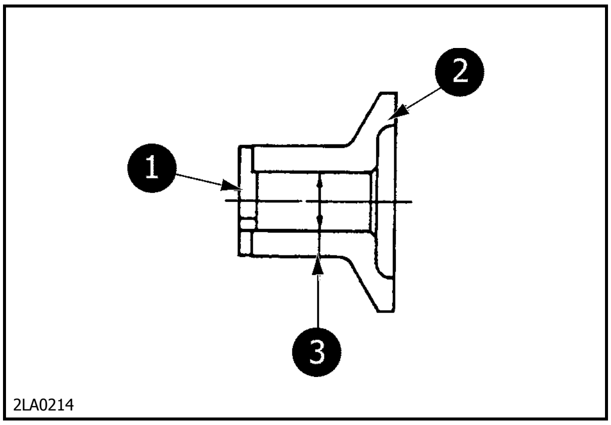
Key:

1. Pin
2. Centrifugal weight of the regulator
3. Support of the centrifugal weights of the regulator

Regulator sleeve inspection

Examine the regulator sleeve to make sure that it is in a good condition and functional. It should be replaced in the following cases:

- if the surface on which the sleeve contacts the centrifugal weights is worn;
- if the surface on which the sleeve contacts the thrust pin is worn;
- if the sleeve fails to move smoothly on the camshaft of the injection pump (e.g. owing to wear on the inner diameter of the sleeve itself);
- if the retainer of the centrifugal weight support is excessively worn.



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Key:

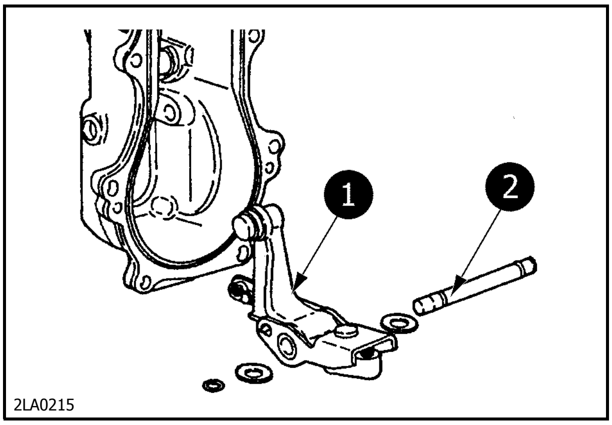
1. Contact surface of the thrust pin
2. Contact surface of the centrifugal weights of the regulator
3. Inner sleeve diameter

Regulator lever shaft assembly inspection

1. Measure the play between the shaft (2) of the regulator lever and the bush (1) and replace if the value is near to the wear limit.

	Normal dimension	Play normal (mm)	Wear limit (mm)
Outer diameter of the regulator lever shaft	7.986 – 7.995	0.065 – 0.124	0.5
Inner bush diameter	8.060 – 8.110		

2. Check the condition of the thrust pin’s contact surface. If there are signs of wear or scorching, remove the pin of the spring in order to demount and replace the thrust pin only.



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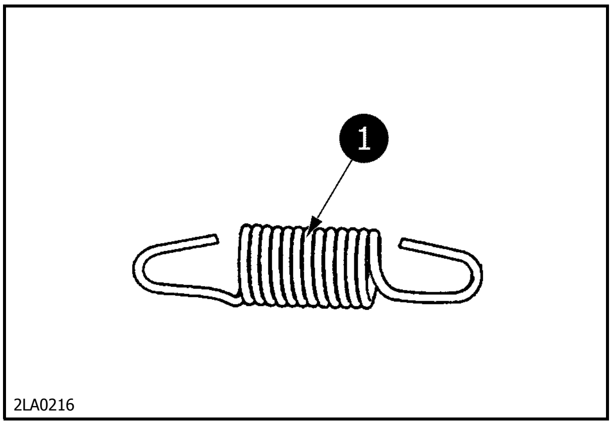
3. Check whether the connection components show signs of warping or twisting which could lead to faulty operation. Replace any defective parts.
   - Float on the upper part of the regulator lever shaft = 0.4 mm.
   - If necessary, replace the lever of the regulator, the tensioning lever, the bush, the thrust pin and the torque adjuster spring, considering them a complete assembly.

Spring inspection

Check the spring (1) of the regulator and the other springs. Replace them if they are broken, rusted or yielding.



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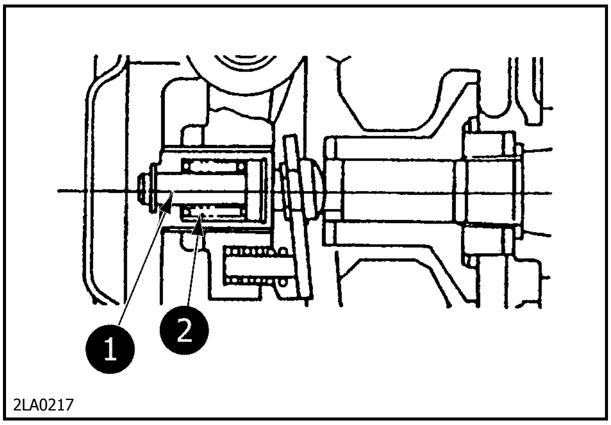
Checking the torque adjuster spring assembly

1. Check the sliding surfaces of the thrust pin (1) and replace it if it is defective.
2. Replace the torque adjuster spring assembly (2) if the spring is broken.



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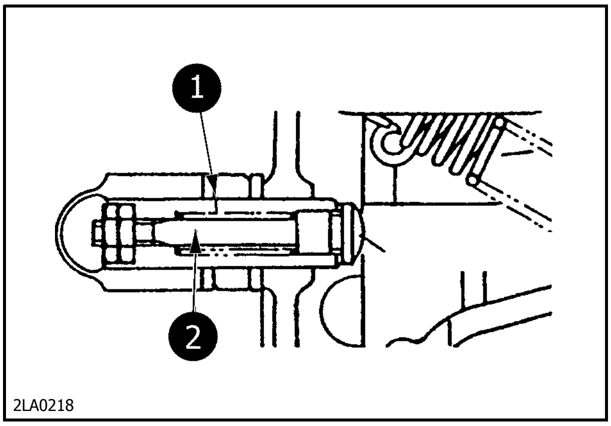
Checking the torsion spring assembly

1. Check the wear at the top of the piston (2) and the contact surface. Replace the parts if they appear to be worn or defective.
2. Replace the assembly if the torsion spring (1) is broken.



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SECTION 300

CLUTCH

INDEX

GENERAL SPECIFICATIONS OF THE LX 9”/9” CLUTCH

Type Control Engaging and disengaging mechanism	unit with two single-plate dry clutch assemblies mechanical: pedal operated for the gearshift clutch; with hand lever for the PTO clutch single Belleville washer
Type of coating on the driven disc of the gearshift clutch Type of coating on the driven disc of the PTO clutch	organic organic

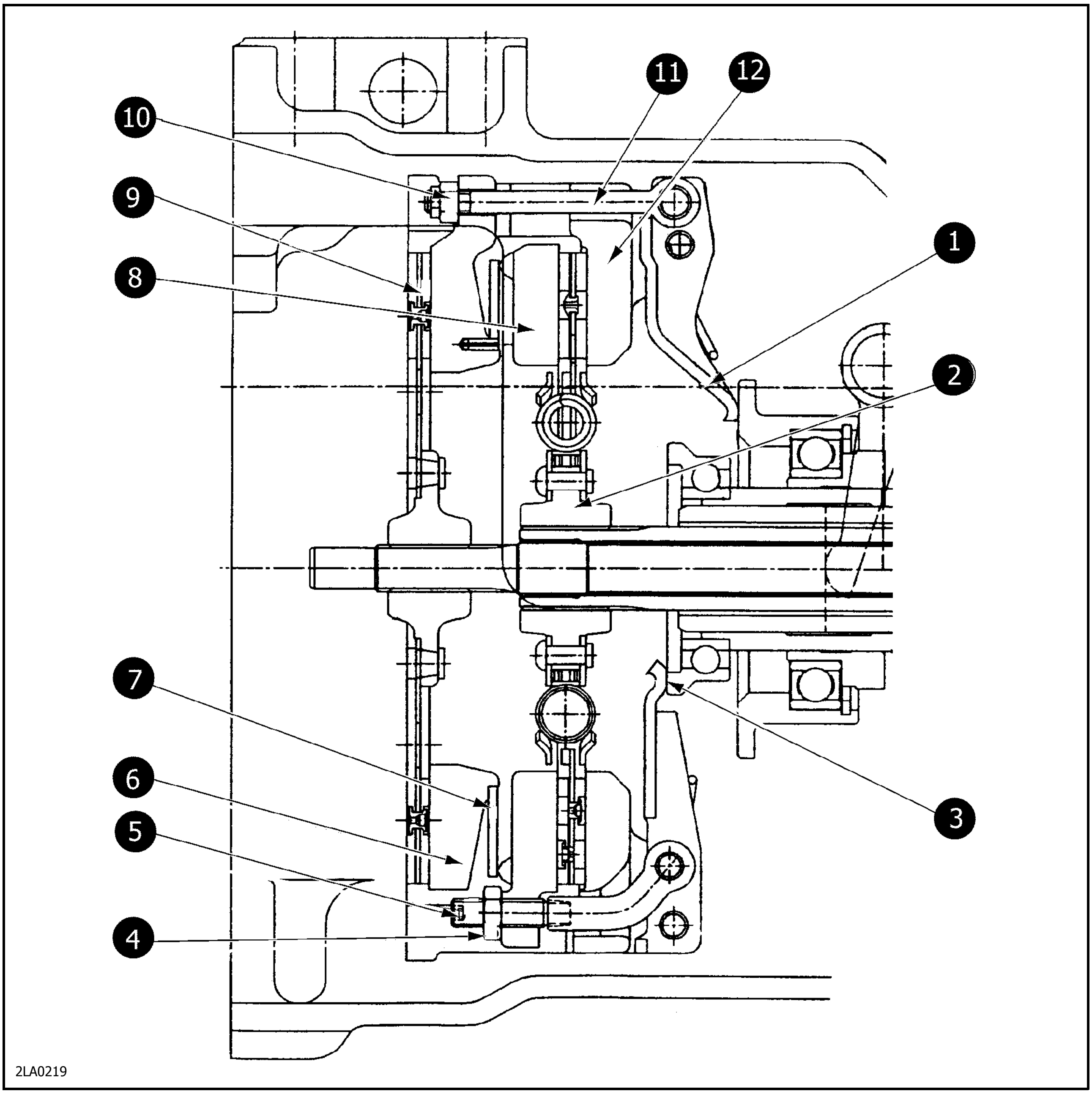
DRIVING TORQUE VALUES

PARTS TO TORQUE	Thread	Driving torque values	
		Nm	kgm
Screws fixing 9”/9” clutch to the flywheel	M 8 x 1.25	20 - 25	2 – 2.5
Nuts fixing clutch housing to the engine	M 12 x 1.25	117 - 129	11.6 – 13.1

SPECIFIC EQUIPMENT

Code	Description
001 FRI MIS	Clutch assembly centring tool
002 FRI MIS	Clutch assembly adjuster tool
003 FRI MIS	Clutch assembly adjuster journal

SECTIONS



1

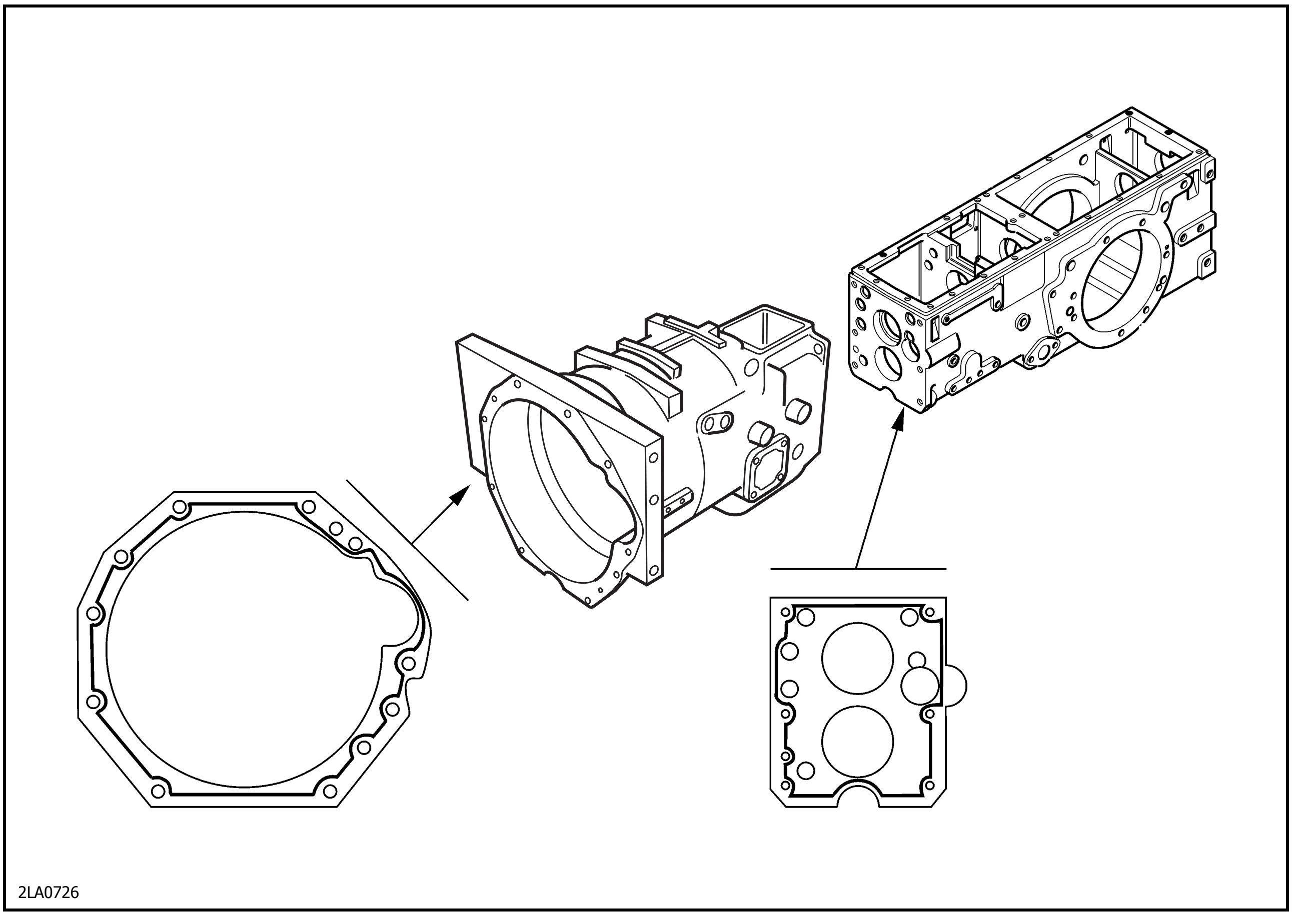
Longitudinal section of the Lx 9”/9” clutch

1. PTO clutch control lever
2. Gearshift clutch friction disc
3. Gearshift clutch control lever
4. Nut
5. Screw to adjust the height of the gearshift clutch dis-engaging lever
6. Pressure plate
7. Belleville washer
8. Pressure plate
9. PTO clutch friction disc
10. Nut to adjust height of PTO clutch control lever
11. Rod
12. Clutch unit

TROUBLESHOOTING FOR THE CLUTCH ASSEMBLY

Faults	Possible causes	Remedies
The clutch slips	**1.** Wear on the discs (2 and 9, fig 1) of the pressure plates and flywheel.	Compare with the values given in the indicated pages. Replace excessively worn parts and adjust the levers and clutch controls.
	2. Belleville washer (7, fig. 1) stretched or damaged.	Replace the Belleville washer.
	3. Oil or grease on the disc friction material (2 and 9, fig. 1).	Replace the discs. Eliminate the cause that led to the presence of lubricant in the clutch housing and thoroughly clean the friction surfaces.
The clutch jerks	**1.** External controls hardened.	Check the hinging and lubricate.
	2. Warped clutch plate (2, fig. 1).	Replace the disc and adjust the clutch lever.
	3. Oil or grease on the disc friction surfaces (2 and 9, fig. 1).	Replace the discs. Eliminate the cause that led to the presence of lubricant in the clutch housing and thoroughly clean the friction surfaces.
The clutch fails to disengage and drags	**1.** Warped clutch plates (2 and 9, fig. 1).	Replace the discs (make the adjustments).
	2. External controls seized.	Check, replace the faulty parts and lubricate.
	3. Badly adjusted controls.	Adjust the controls (see page18).
Clutch noisy when engaged and/or disengaged	**1.** Worn thrust bearings.	Replace the bearing
	2. Clutch plate (2, fig. 1) with faulty springs.	Replace the plate.
Clutch pedal too hard to operate	**1.** External controls hardened.	Check the hinging and lubricate.
	2. Hardened pedal hinging.	Check the hinging and lubricate.

WHERE THE SEALANT IS APPLIED FOR THE CLUTCH HOUSING ON THE TRANSMISSION HOUSING



2

The types of sealant to apply are indicated in section 100.

CLUTCH SPLITTING-REMOUNTING

Splitting

DANGER

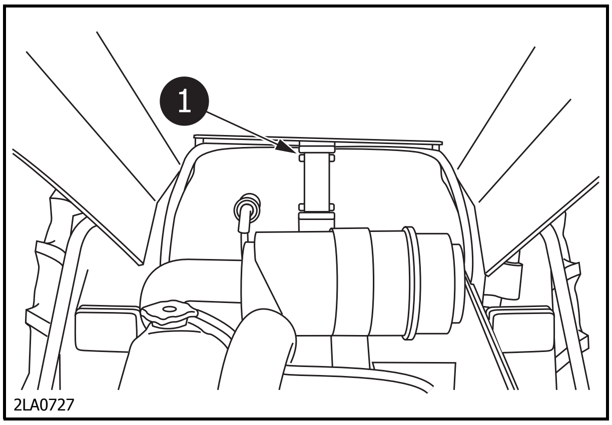
Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units of parts are supported by appropriately sized harness and hooks. Make sure that there are no bystanders near the load being lifted.

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

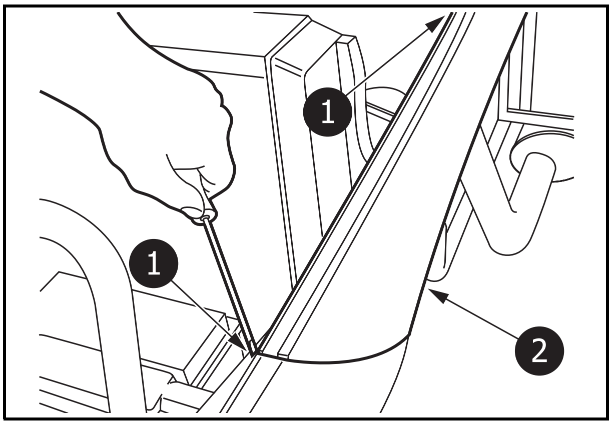
Proceed as follows:

1. Unscrew the screw (1) and remove the bonnet.



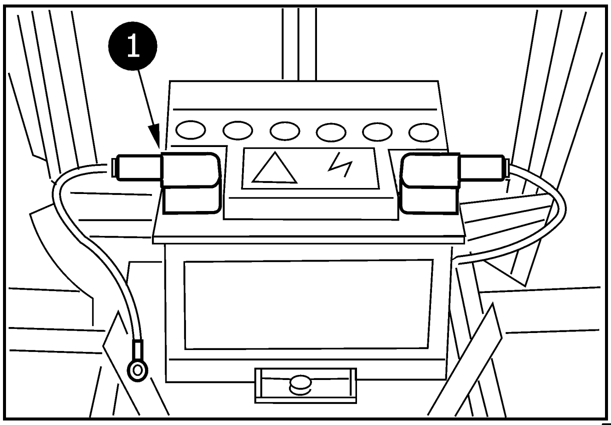
3

2. Unscrew the fixing screws (1) and remove the side panels (2) (from both sides).



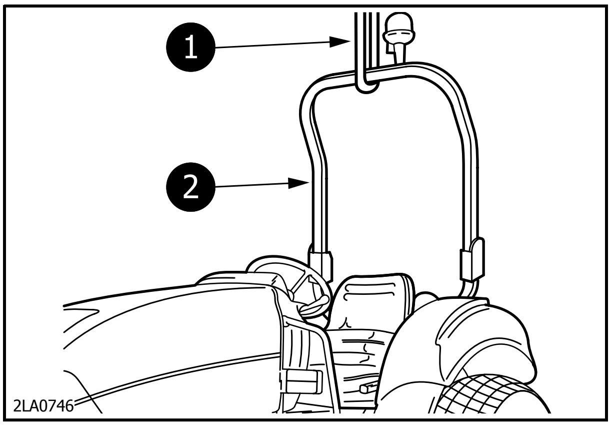
4

3. Loosen the clamp bolt (1) and disconnect the negative battery wire.



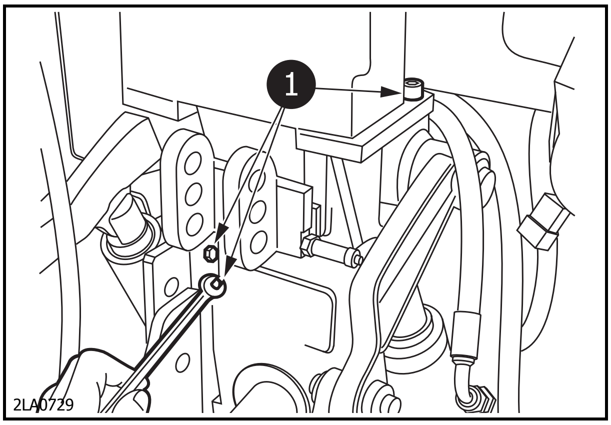
5

4. Fix the rear safety frame (2) to a hoist (1) and tighten the belt.



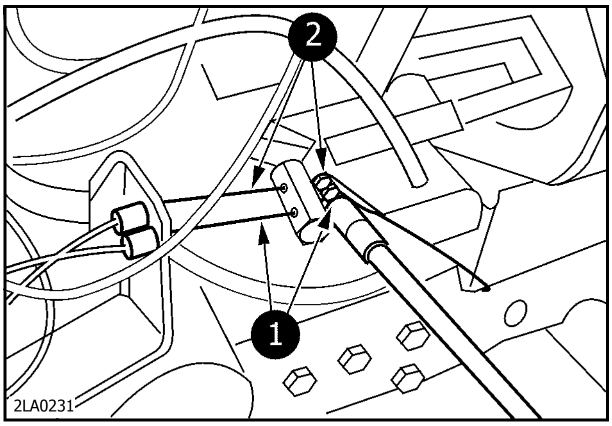
6

5. Unscrew the fixing screws (1) and remove the rear safety frame (2) by means of a hoist.



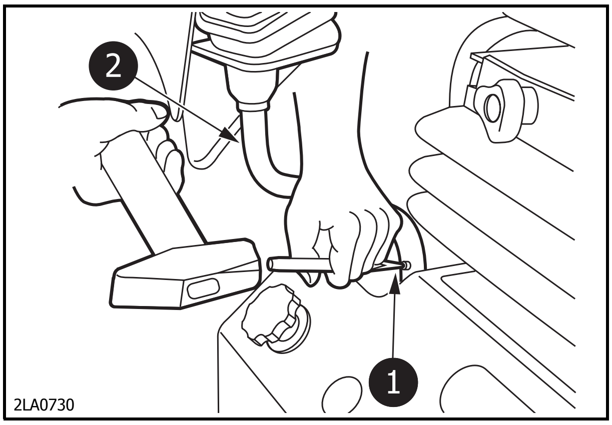
7

6. Detach the pedal accelerator wire (1) and the hand throttle wire (2).



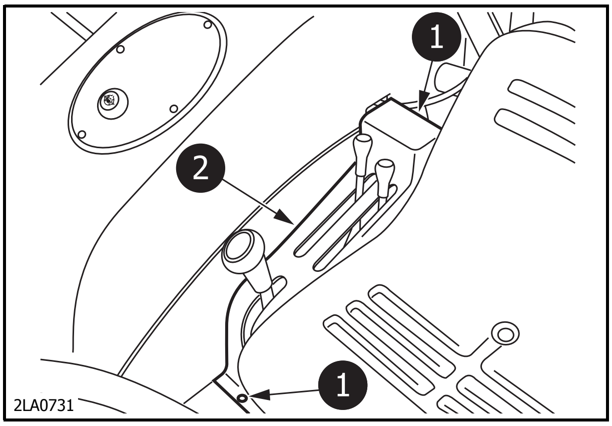
8

7. Using a pin driver, remove the spring pin (1) and take out the gear lever (2).



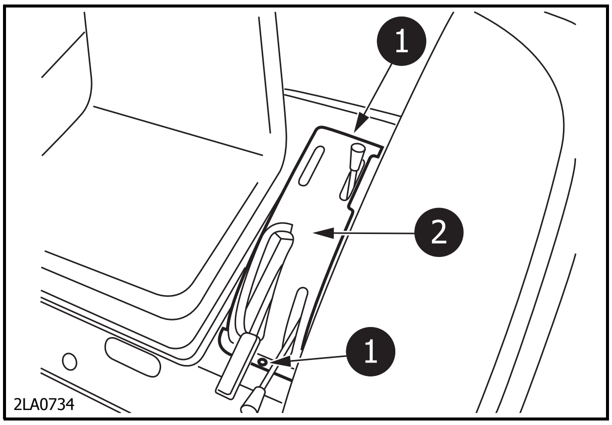
9

8. Unscrew the fixing screws (1) and remove the guard from the controls (2) on the right-hand side of the seat.



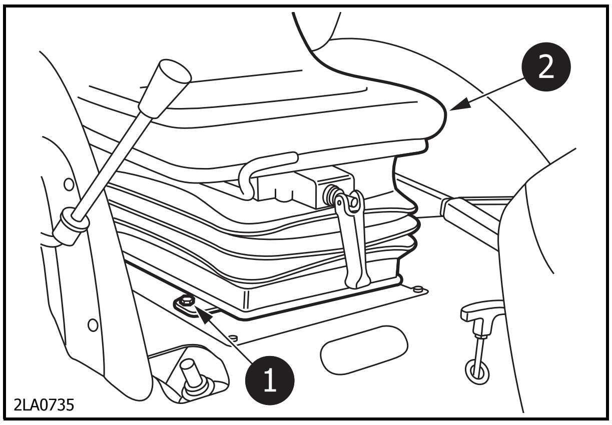
10

9. Unscrew the fixing screws (1) and remove the guard from the controls (2) on the left-hand side of the driver's position.



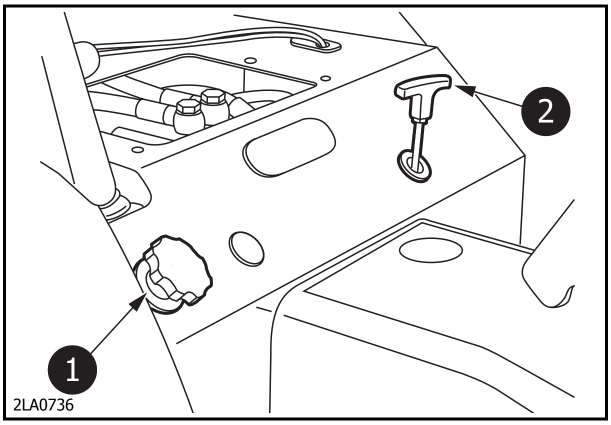
11

10. Unscrew the fixing screws (1) and remove the seat (2).



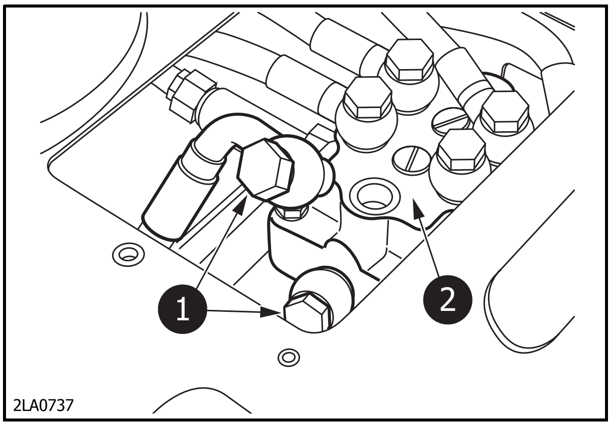
12

11. Remove the knob (1) that regulates the sensitivity of the power lift and the 4WD engaging lever (2).



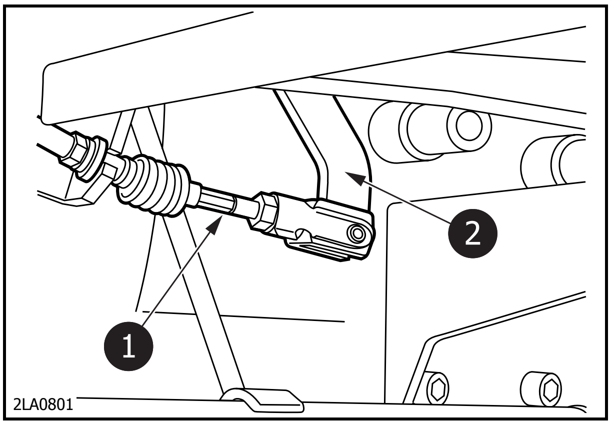
13

12. Disconnect the hydraulic pipe unions (1) from the auxiliary control valve unit.



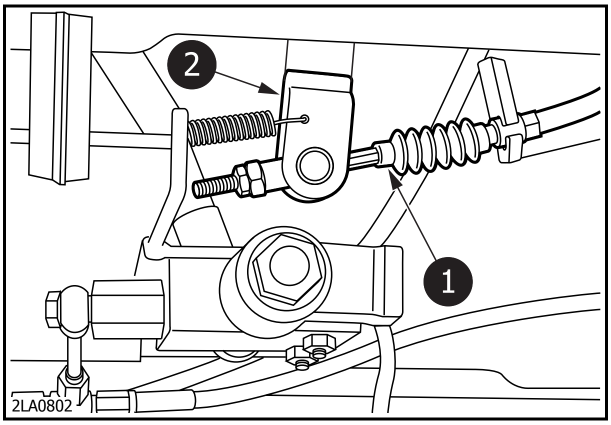
14

13. Disconnect the flexible cable (1) from the control lever (2) of the fork that disengages the gearshift clutch.



15

14. Disconnect the flexible cable (1) from the control lever (2) of the fork that disengages the PTO clutch.



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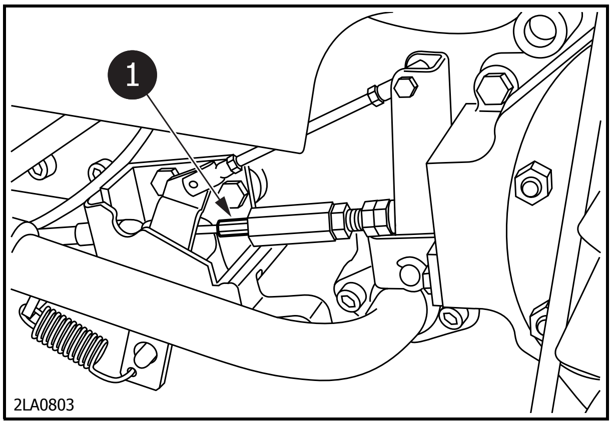
15. Disconnect the flexible cable (1) that controls the brake (on both sides).



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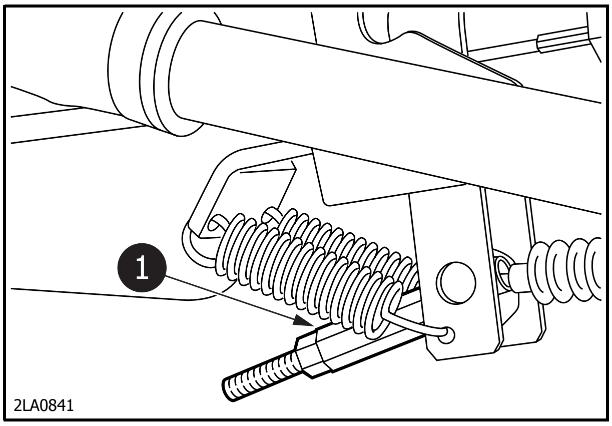
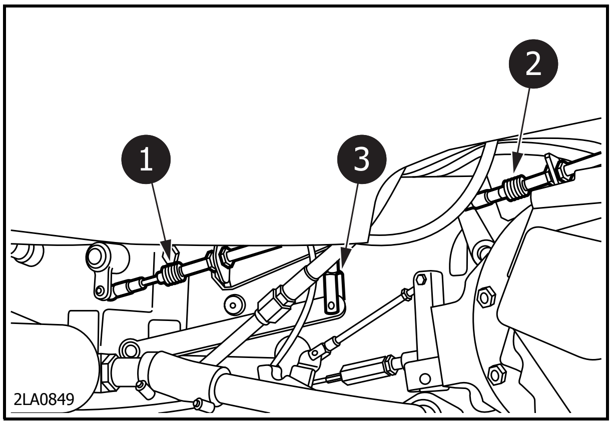
16. Disconnect the flexible cable (1) that controls the parking brake.



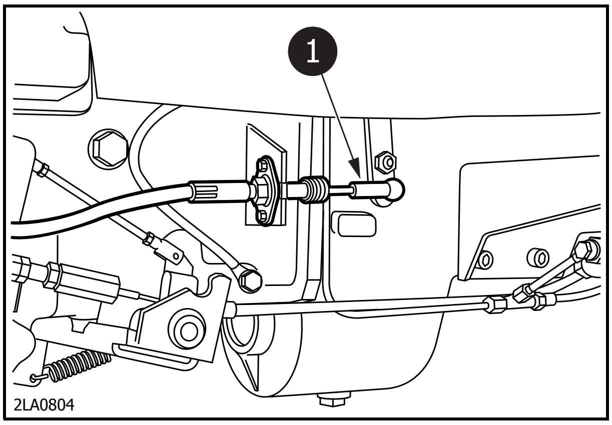
18

17. Disconnect the flexible cable (1) that controls PTO engagement, PTO speed selection (2) and the rigid rod that engages the 4WD (3).



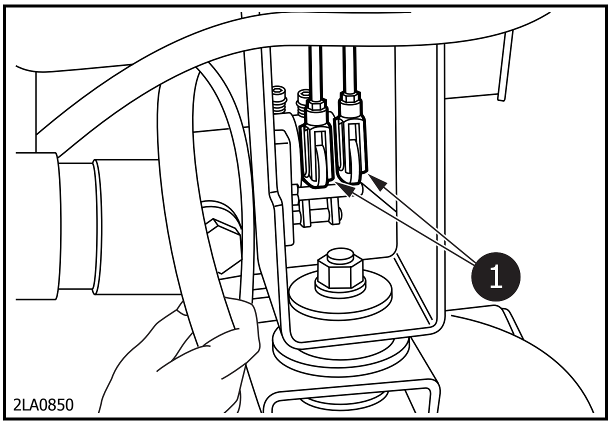
19

18. Disconnect the flexible cable (1) that controls the range selection function.



20

19. Detach the rods (1) that control the power lift valve system.



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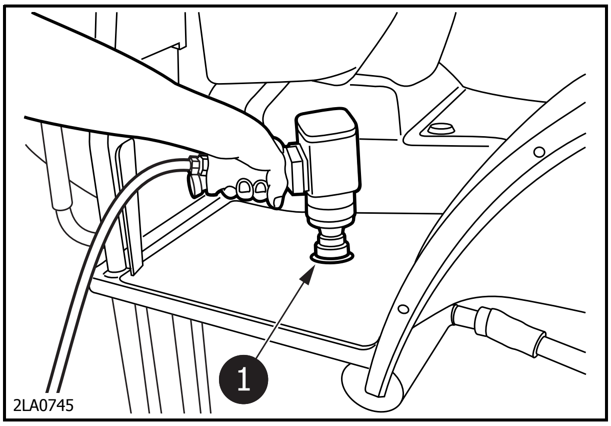
20. Unscrew the front fixing bolts (1) of the platform in the zone where the feet rest on both sides of the tractor.



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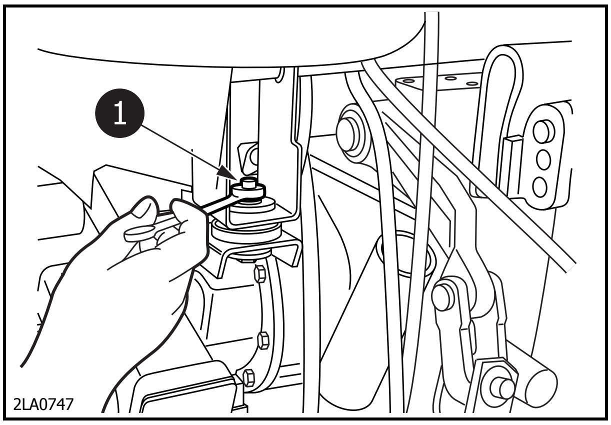
21. Unscrew the rear fixing bolts (1) of the flexible support of the platform in the zone where the side final drive is installed on both sides of the tractor.



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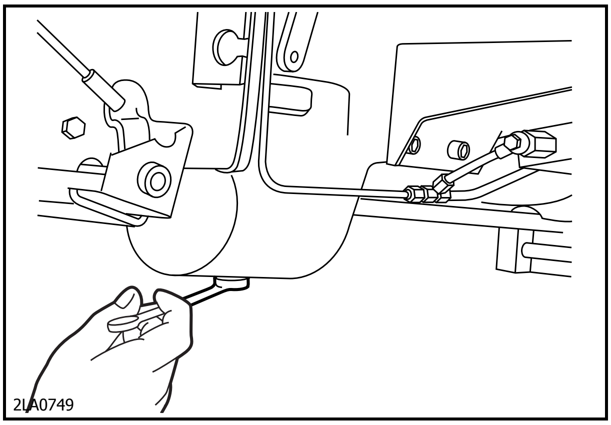
22. Detach the front ballast (if installed), using a hoist and two steel ropes.

23. Remove the oil from the gearbox – rear transmission, by unscrewing the plug under the gearbox itself.

	Old oil must be disposed of in compliance with the current laws in merit.



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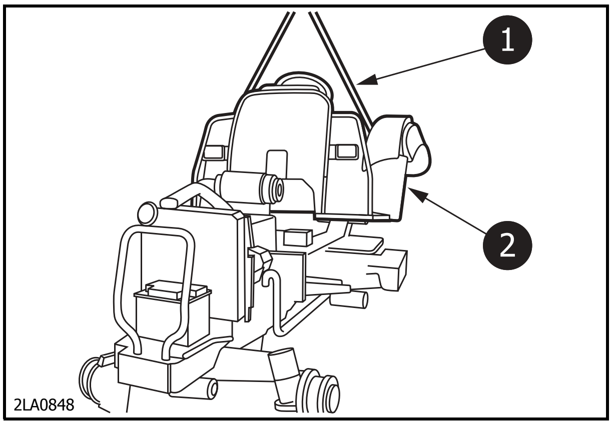
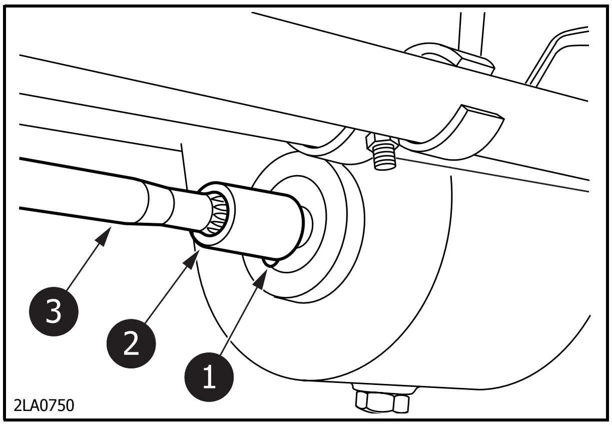
24. Remove the complete platform (2) using a hoist (1).



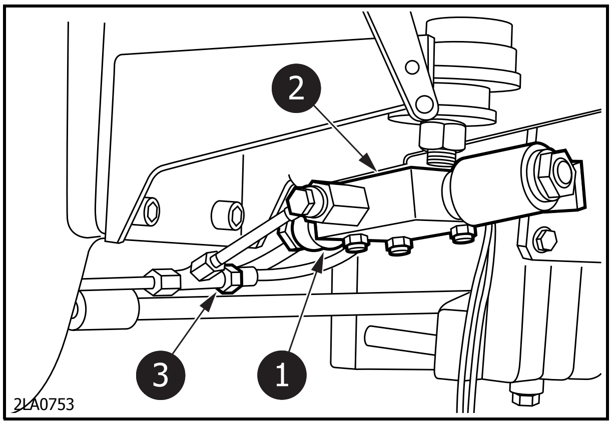
25

25. Using a pin driver, remove the spring pin (1), slide the coupling sleeve (2) and remove the 4WD shaft (3) (these operations must be carried out on both ends of the shaft).



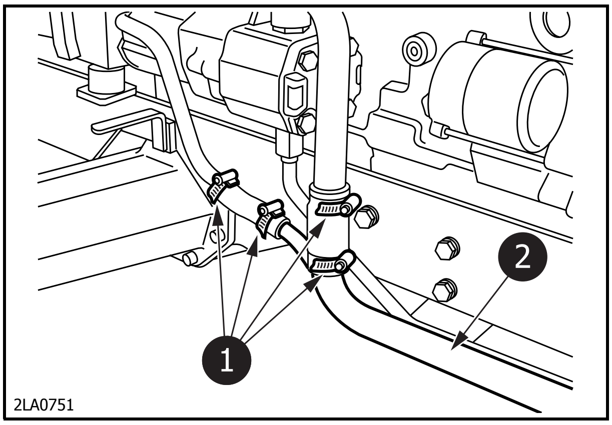
26

26. Disconnect the hydraulic pipe unions (1) from the diff lock solenoid valve (2) and disconnect the front diff lock hose (3).



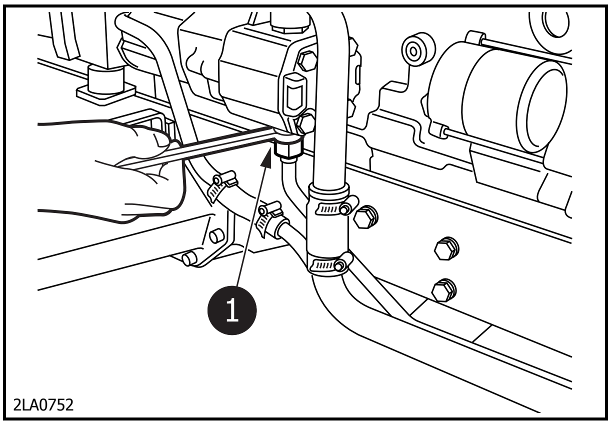
27

27. Loosen the closing clamps (1) and remove the transmission lubricating oil inlet hose (2).



28

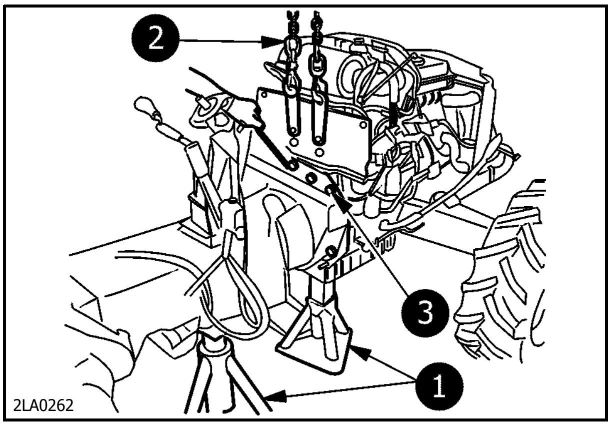
28. Disconnect the union (1) of the oil delivery hose from the pump to the power lift valve system pump and to the auxiliary control valve.



29

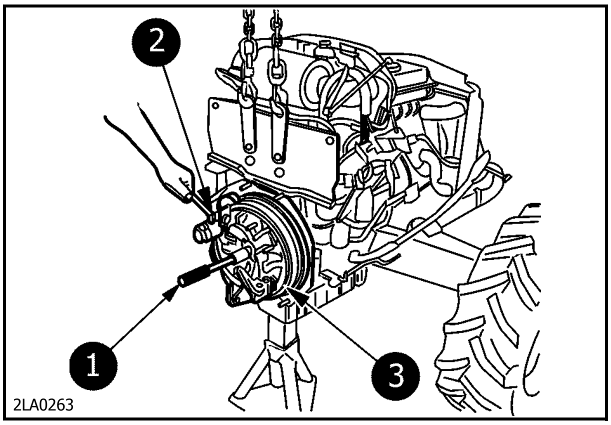
29. Place two fixed stands (1), one under the engine oil sump and the other under the fromt part of the clutch housing. Fix two chains (2) to the rear hooks on the engine and to the hoist and pull on this latter.

30. Block the front axle with a chock to prevent the engine from swinging, then unscrew the bolts (3) that fix the clutch housing to the engine and split the clutch housing from the engine.



30

31. Using tool **001 FRI MIS** (1), unscrew the fixing screws (2) and remove the clutch (3).



31

Remounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

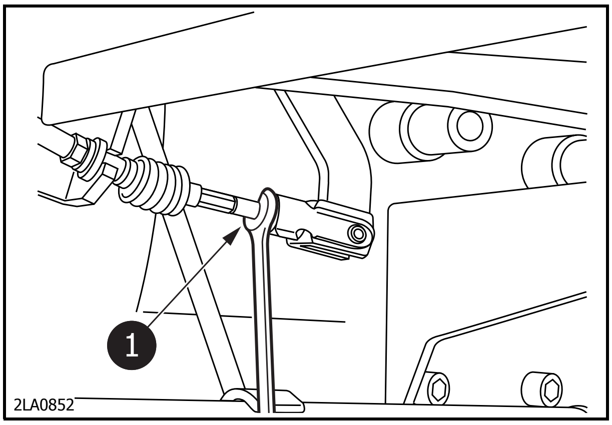
Fit the engine back on to the clutch housing bearing the following recommendations in mind:

- Apply the driving torques listed on page 3.
- Before the engine is fitted back on to the clutch housing, thoroughly clean and degrease the surfaces to be coupled and apply a strip of sealant with a diameter of about 2 mm, following the line shown on page 7. 7.
- Fix the clutch back on to the flywheel using tool **001 FRI MIS**.
- Using tool **002 FRI MIS** and cross **003 FRI MIS** , adjust the clutch levers in order to obtain 0.1 mm play between the end of the actual lever and the cross.
- Using a hoist, couple the engine-front axle assembly and fix it in place.
- Connect the hose that delivers oil to the power lift valve system and to the auxiliary control valve.
- Connect the gearbox lubricating oil hose.
- Connect the hydraulic hoses of the front and rear differential locks.
- Remount the 4WD shaft.
- Screw on the plug that drains the oil from the rear transmission oil and fill with oil (see section 100).
- Position and fix the platform.
- Position and fix the rear safety frame.
- Connect the control rods of the power lift valve system.
- Connect the flexible cable that controls the range selection function.
- Connect the 4WD engaging rod.

- Connect the flexible cable that selects the PTO speed.
- Connect the flexible cable that engages the PTO.
- Connect the brake cables.
- Connect the flexible cable of the PTO clutch control lever.
- Connect the flexible cable of the gearshift clutch control lever.
- Position and fix the lifting valve system.
- Position and fix the seat.
- Connect the accelerator control cables.
- Position and fix the rear safety frame.
- Fix the side panels of the engine in place.
- Fix the bonnet in place.

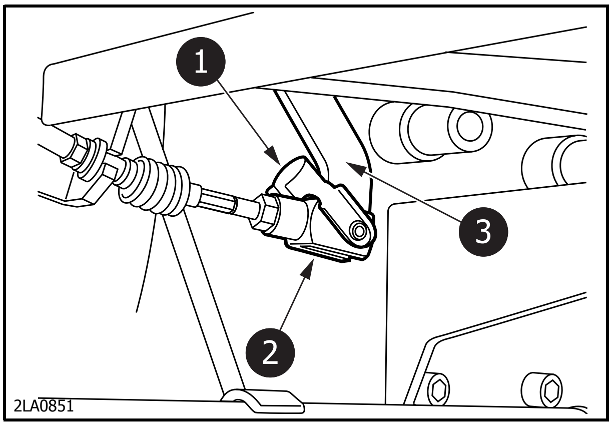
CONTROL ADJUSTMENT
GEARSHIFT CLUTCH

1. Loosen the check nut (1).



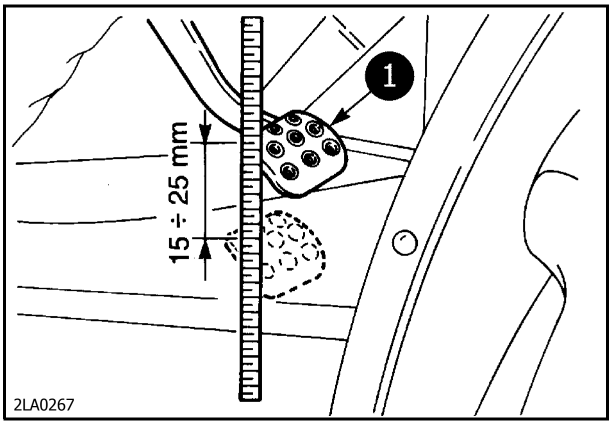
32

2. Remove the fixing pin (1) and disconnect the fork (2) from the clutch control lever (3). Tighten or loosen the fork in order to adjust the clutch control.



33

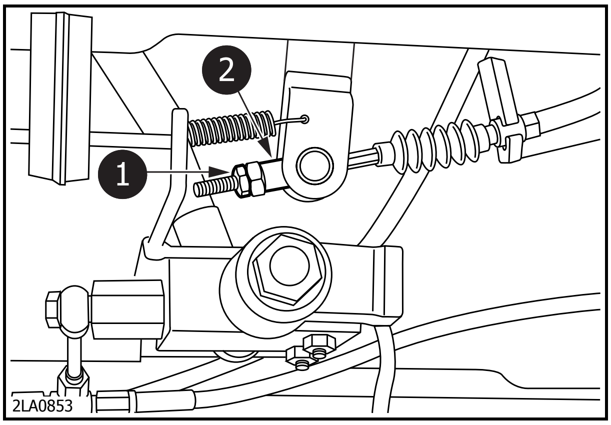
3. Re-position the fork (2, fig. 33) and the fixing pin (1, fig. 33).
4. Make sure that the clutch pedal (1) travel is between 15 and 25 mm.
5. Lock the check nut (1, fig. 32).



34

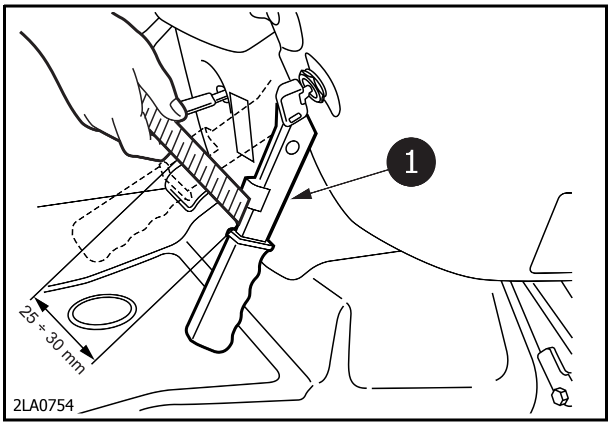
CONTROL ADJUSTMENT
POWER TAKE-OFF CLUTCH

1. Loosen the check nut (1). Tighten or loosen the adjuster (2) to regulate the clutch control.



35

2. Make sure that the idle travel of the clutch pedal (1) is between 25 and 30 mm.
3. Lock the check nut (1, fig. 35).



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SECTION 400

(12 + 12) AND (16 + 16) MECHANICAL GEARBOX

INDEX

MAIN SPECIFICATIONS OF THE GEARBOX AND FINAL DRIVE

Gearbox		with 4 ratios, infinitely meshed gears and synchronizers for all speeds
Type of gears.		with helical toothing
Final drive	(mm)	cascade type with 3 speed ranges for a total 12 speeds.
- Type of gears.	(mm)	with straight toothing
Gearbox and final drive controls.	(mm)	independent, with lever installed on the operator’s right, under the steering wheel
Thickness of main shaft adjuster ring (SP_2, fig. 3)	(mm)	1.00 – 1.10 – 1.20 – 1.30 – 1.40 – 1.50 – 1.60 – 1.70 – 1.80
Thickness of reverse shuttle gear adjuster ring (SP_1, fig. 2)	(mm)	1.00 – 1.10 – 1.20 – 1.30 – 1.40 – 1.50 – 1.60 – 1.70 – 1.80

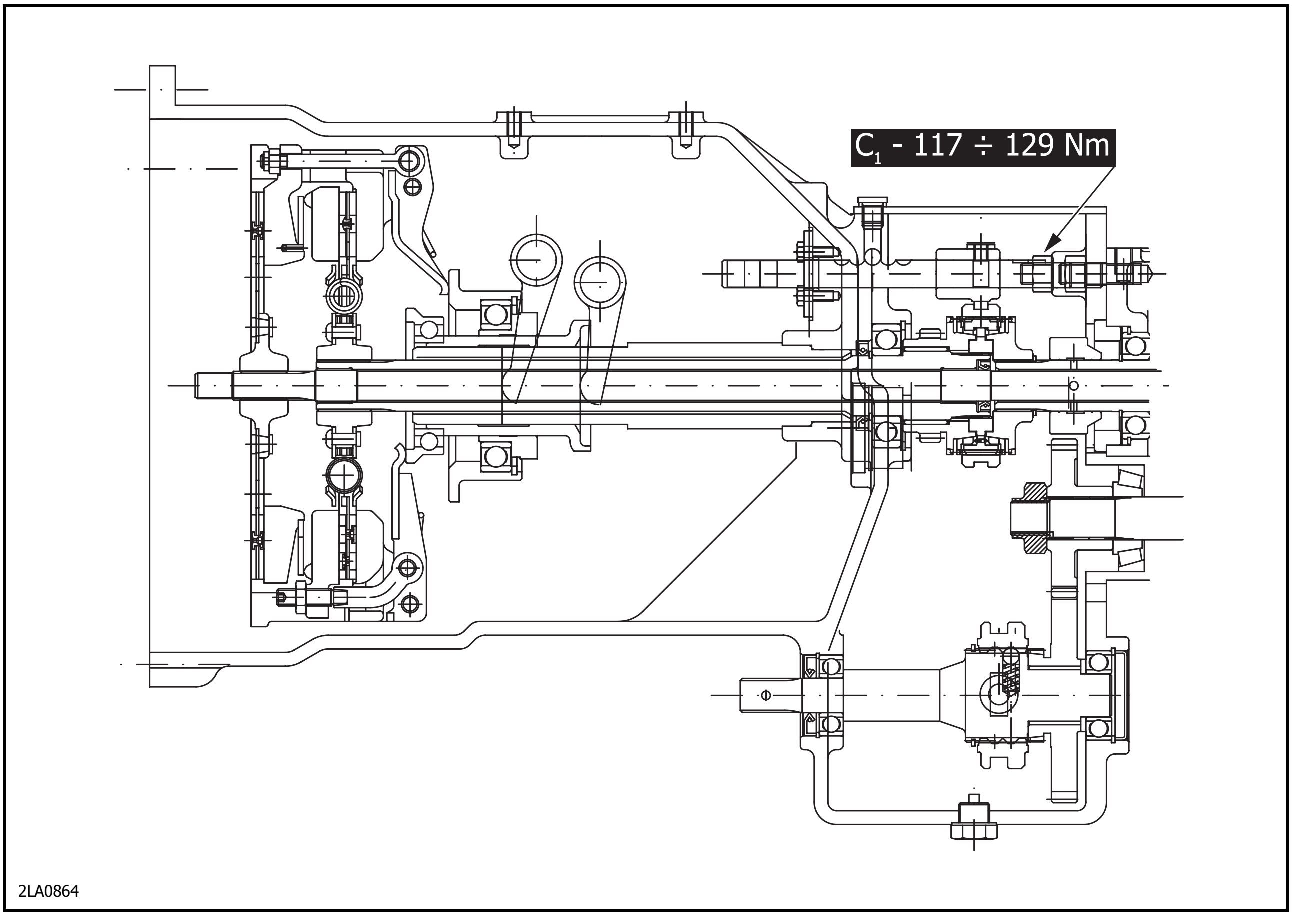
MAIN SPECIFICATIONS OF REVERSE SHUTTLE

Type	mechanical with straight teeth, installed between the main clutch and gearbox.
Control	by means of dedicated lever on the operator’s left

MAIN SPECIFICATIONS OF THE SUPPLEMENTARY FINAL DRIVE (16 + 16 VERSION)

Type	cascade with straight teeth, installed between the gearbox and bevel gear pair. Obtains 16 forward and 16 reverse speeds
Control	by means of dedicated lever on the operator’s right

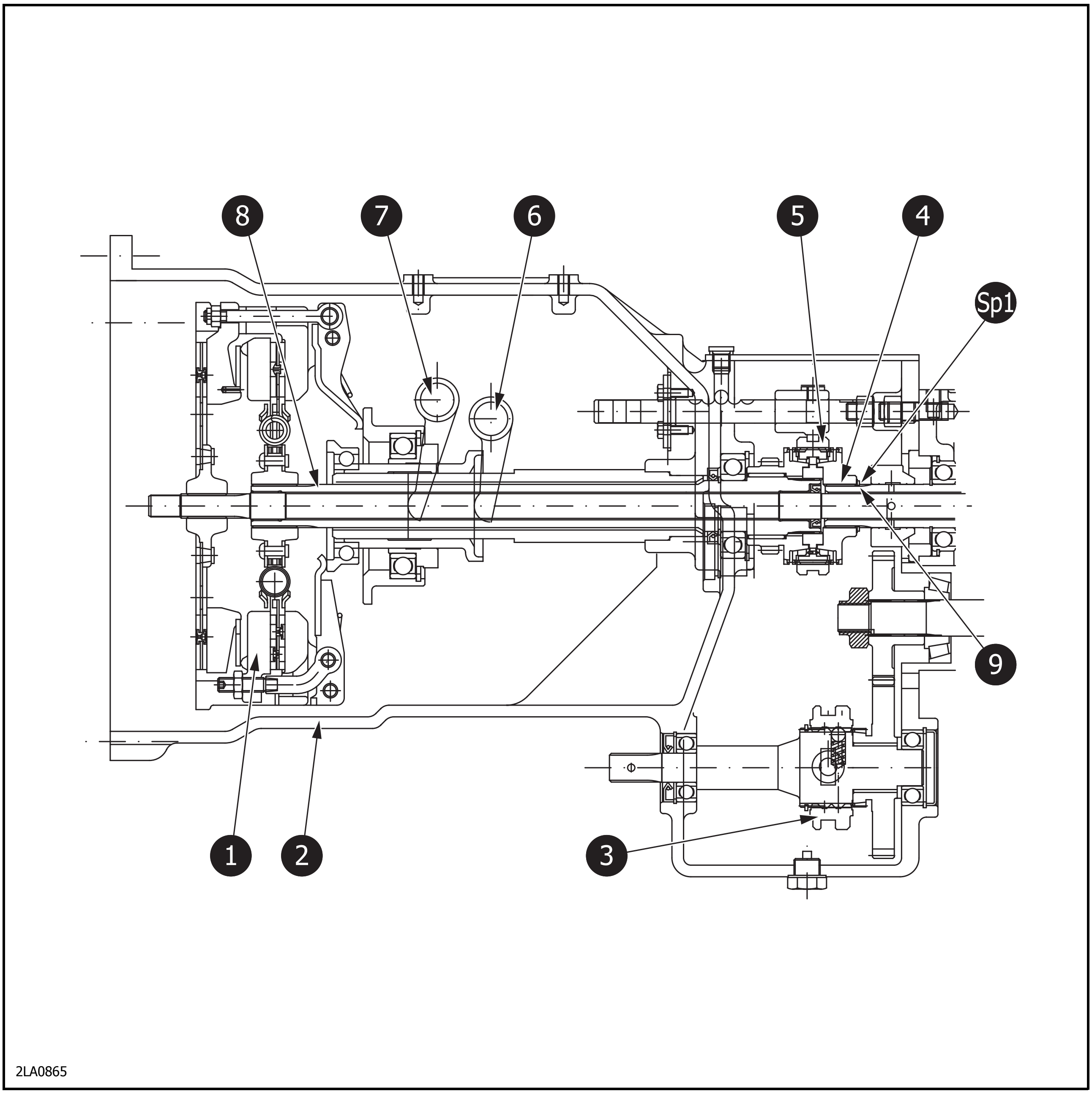
DRIVING TORQUE VALUES



1

PARTS TO TORQUE	Thread	Driving torque values	
		Nm	kgm
Screw fixing the clutch housing to the gearbox-rear transmission housing (C_1)	M 12 x 1.25	117 - 129	11.9 – 13.1
Gearbox housing cover fixing screws	-	43 - 51	4.4 – 5.2
Pressure switches	-	51 - 72	5.2 – 7.3

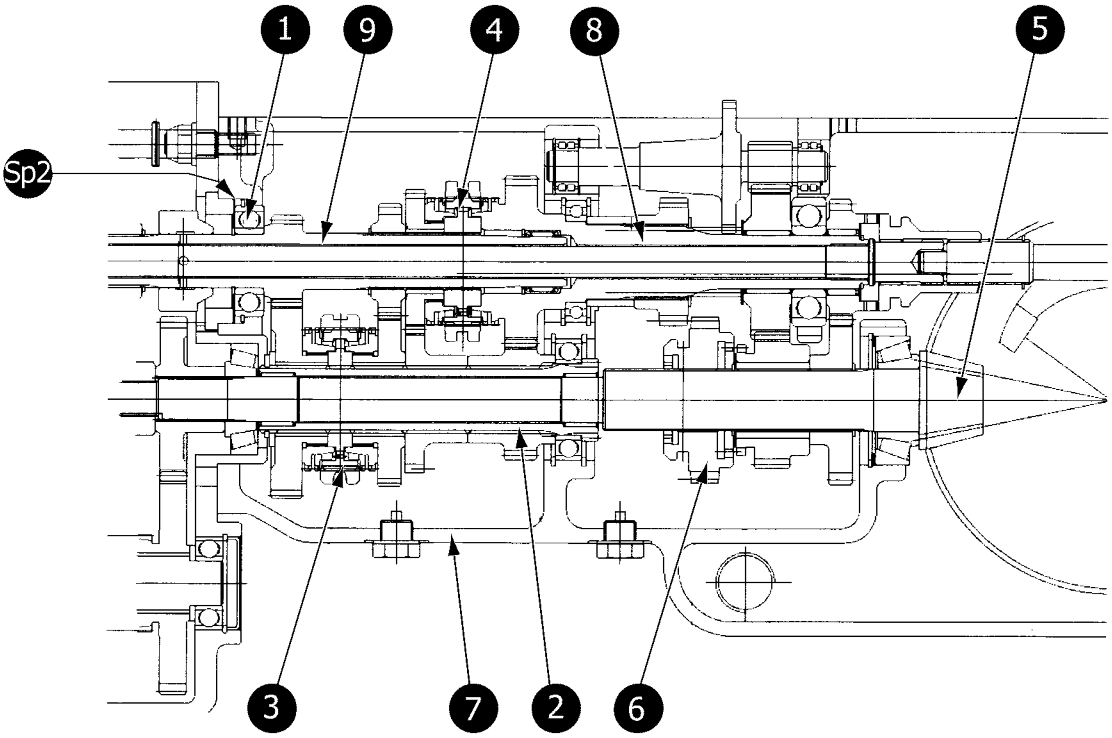
SECTIONS



2

Longitudinal section of the clutch housing

Th_1 Adjuster shims.
1. Clutch
2. Clutch housing.
3. 4WD engaging unit.
4. Reverse shuttle unit.
5. Reverse shuttle engaging unit.
6. Shaft for gearbox disc disengaging fork.
7. Shaft for PTO disc disengaging fork.
8. Gearshift control shaft.
9. Spring ring.



3

Longitudinal section of the gearbox and range reduction unit (12 + 12)

Sh_2 Adjuster shims.
1. Ball bearings.
2. Transmission shaft.
3. 1st and 2nd gear synchro-mesh unit.
4. 3rd and 4th gear synchro-mesh unit.
5. Range selector.
6. Gearbox.
7. Upper shaft.
8. Main shaft.
9. Bevel pinion.

DESCRIPTION AND OPERATION.

Gearbox and reverse shuttle

The gearbox is equipped with helical toothed infinitely meshed gears controlled by two synchromesh units. It provides 4 speeds.

The range reduction unit is the cascade type with infinitely meshed straight toothed gears.

The reduction unit provides: 3 forward speed ranges (12 + 12 version) or 4 speed ranges (16 + 16 version).

The gearbox and range reduction unit are controlled by two independent levers installed on the operator's right under the steering wheel.

The reverse shuttle is a mechanical device that provides: 12 forward and 12 reverse speeds (12 + 12 version), or 16 forward and 16 reverse speeds (16 + 16 version). It is controlled by a dedicated lever installed on the operator's left under the steering wheel.

The reverse shuttle consists of a straight toothed gear. The reverse shuttle is engaged by means of a synchromesh.

The reverse shuttle is installed inside the clutch housing, between the actual clutch itself and the gearbox.

The assembly is lubricated by the oil in the gearbox-rear transmission housing.

Supplementary final drive (16 + 16 version)

The supplementary final drive is a mechanical device that provides 16 forward and 16 reverse speeds:

The supplementary final drive only becomes operative in the slow ranges.

The supplementary final drive is installed prior to the gearbox and is controlled by a dedicated lever on the platform, to the operator's right.

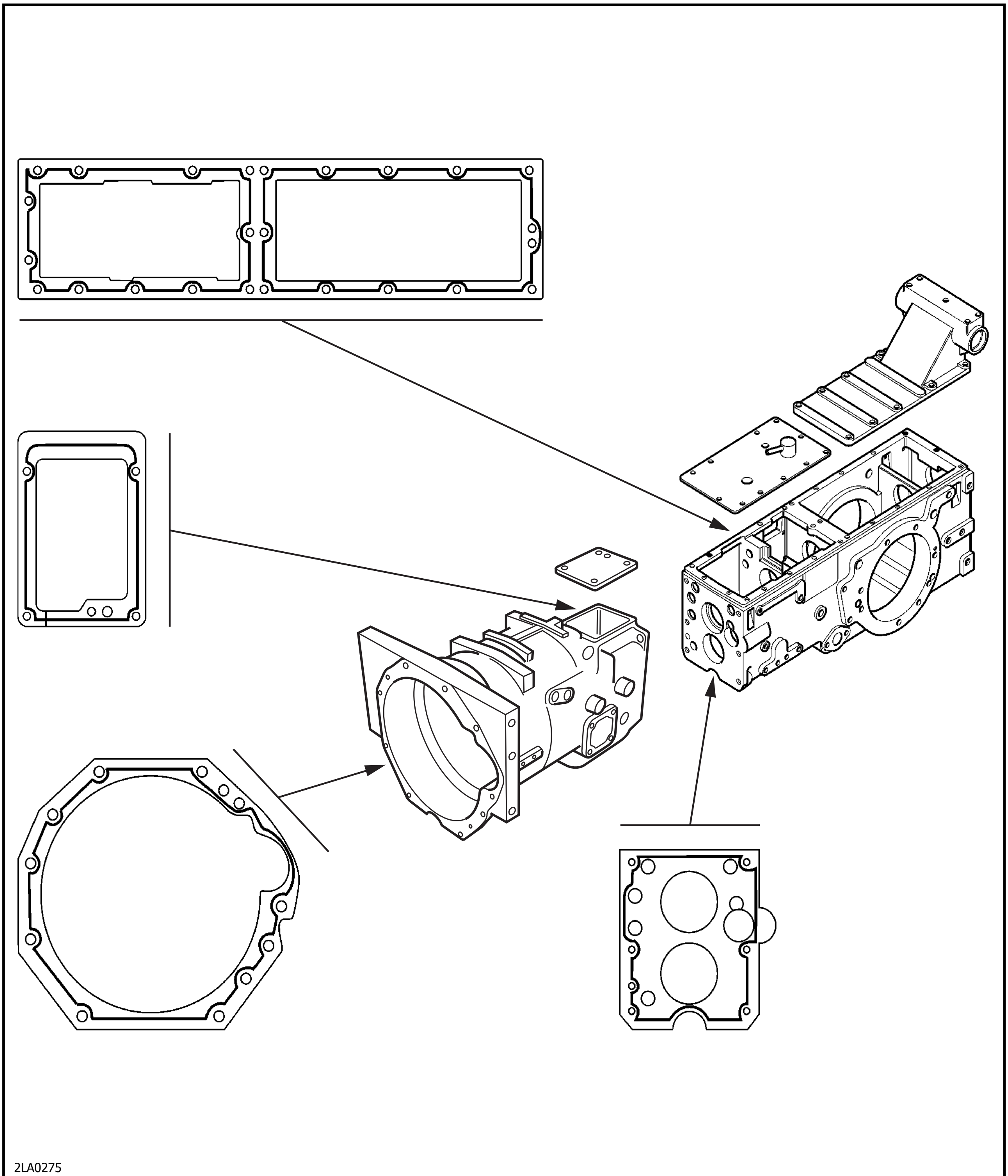
TROUBLESHOOTING FOR THE GEARBOX, FINAL DRIVE AND REVERSE SHUTTLE

Faults	Possible causes	Remedies
The gearbox, final drive or reverse shuttle disengage spontaneously.	**1.** Transmission rods and levers incorrectly adjusted.	Adjust correctly.
	2. Faulty control rod retention springs.	Replace the springs.
	3. Faulty synchromesh engaging teeth or engaging sleeves.	Remove the gearbox-transmission housing and replace the synchromesh units or engaging sleeves.
	4. Incomplete engagement travel.	Eliminate the causes and adjust for complete travel.
The gearbox, final drive or reverse shuttle are difficult to engage.	**1.** Transmission rods and levers incorrectly adjusted.	Adjust correctly.
	2. Transmission rods and levers hardened and/or seized.	Check the hinging and lubricate.
	3. The central clutch drags.	See sect. 18.
	4. Faulty synchromesh units or engaging sleeves.	Remove the gearbox-transmission housing and replace the synchromesh units or engaging sleeves.
	5. The internal controls do not slide smoothly. rods, forks and sleeves.	Overhaul the controls.
The gearbox, final drive or reverse shuttle operate in a noisy way.	**1.** Some internal component is worn or defective.	Remove the gearbox-transmission housing and replace the faulty parts.

TROUBLESHOOTING FOR THE SUPPLEMENTARY FINAL DRIVE (16-16 VERSION)

Faults	Possible causes	Remedies
The supplementary final drive disengages spontaneously.	**1.** External transmission rods and levers incorrectly adjusted.	Adjust correctly.
	2. Incomplete engagement travel.	Eliminate the causes and adjust for complete travel.
The supplementary final drive is difficult to engage.	**1.** External rods and levers incorrectly adjusted.	Adjust correctly.
	2. External rods and levers hardened and/or seized.	Check the hinging and lubricate.
	3. The central clutch drags.	See sect. 18.
	4. The internal controls do not slide smoothly. rods, forks and sleeves.	Overhaul the controls.
The supplementary final drive operates in a noisy way.	**1.** Some internal component is worn or defective.	Remove the clutch housing and replace the faulty parts.

WHERE THE SEALANT IS APPLIED FOR THE GEARBOX-REAR TRANSMISSION HOUSING



4

The types of sealant to apply are indicated in section 100.

GEARBOX TRANSMISSION HOUSING SPLITTING-REMOUNTING

Splitting

DANGER

Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units or parts are supported by appropriately sized harness and hooks.
Make sure that there are no bystanders near the load being lifted.

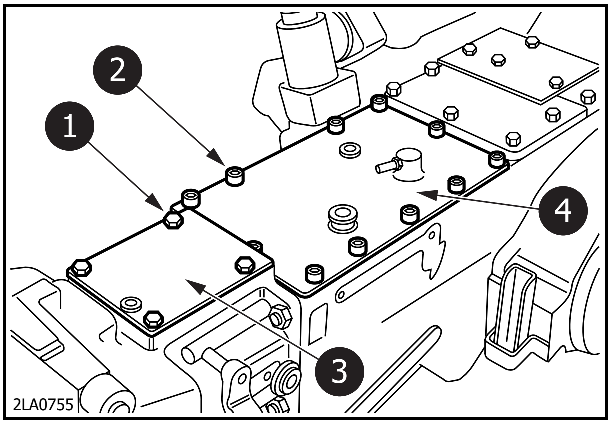
WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

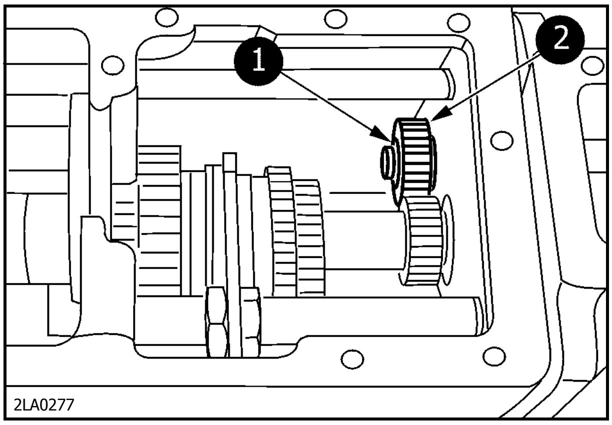
1. Split the clutch (see section 300 up to point 29).

2. Unscrew the fixing screws (1) (2) and remove the cover (3) (4) of the gearbox.



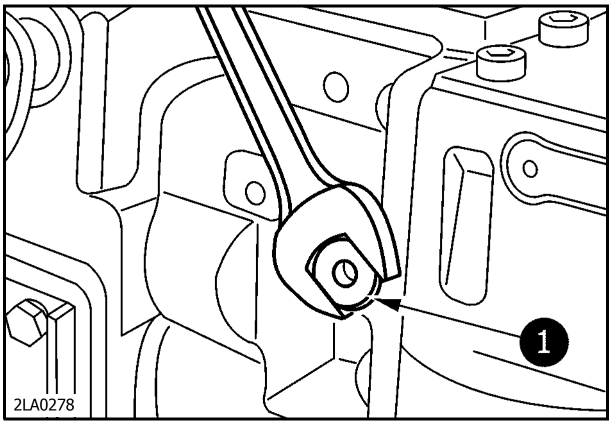
5

3. Remove the spring ring (1) and take out the reverse gear (2).



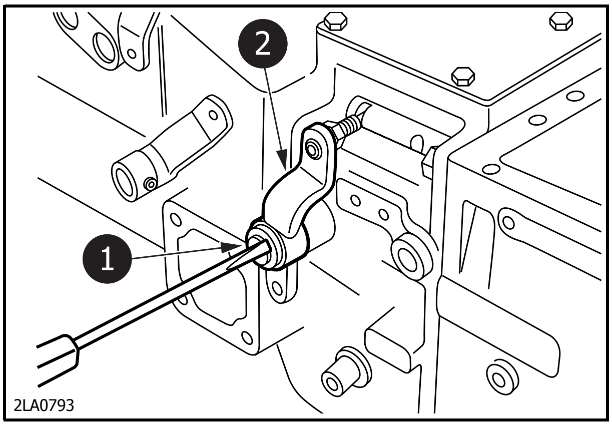
6

4. Unscrew the lubrication union (1) of the main shaft.



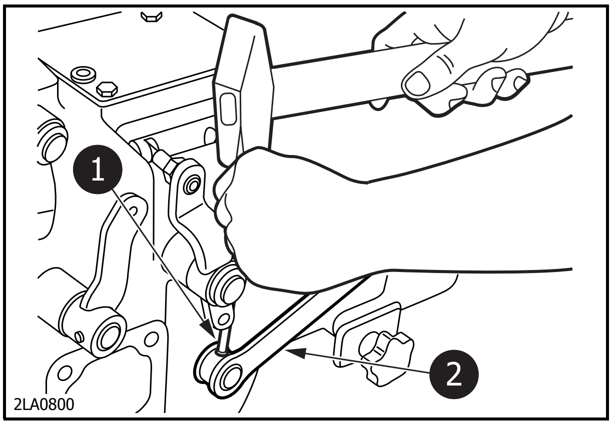
7

5. Remove the spring ring (1) and take out the PTO engaging lever (2).



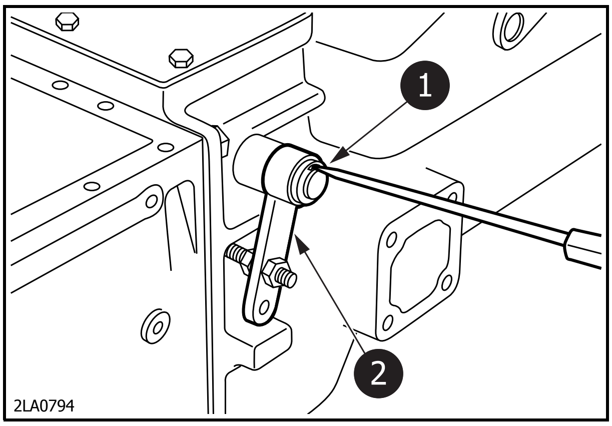
8

6. Remove the spring ring (1) in order to remove the 4WD engaging lever (2).



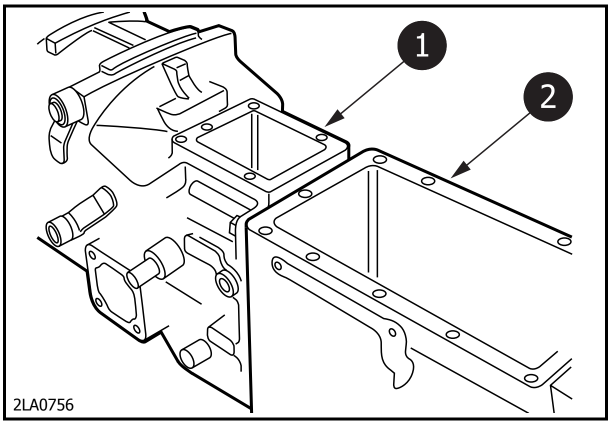
9

7. Remove the spring ring (1) and take out the range selection lever (2).



10

8. Unscrew the fixing screws and split the clutch housing (1) from the gearbox – rear transmission housing (2).



11

Remounting

Comply with the following recommendations when remounting the gearbox-rear transmission housing:

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

- Consult figures 2 and 3 in order to position the various parts correctly.
- Before remounting the housings, supports and covers, thoroughly clean and degrease the coupling surfaces and apply a strip of sealant about 2 mm in diameter as indicated in figure 4.
- Apply the driving torques listed on page 4.
- Fit the clutch housing back on to the gearbox-rear transmission housing.
- Mount the range selection lever, the 4WD engaging lever and the PTO engaging lever.
- Mount the union of the main shaft lubrication hose.
- Mount the reverse gear and relative spring ring.
- Position and fix the gearbox covers.
- Re-connect the clutch (see section 300).

GEARBOX TRANSMISSION HOUSING - OVERHAUL

Demounting

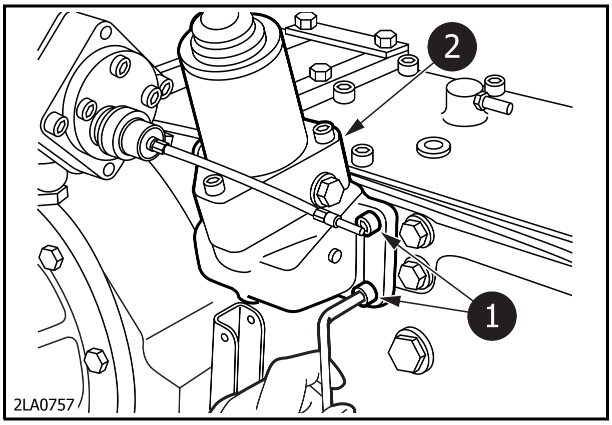
WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

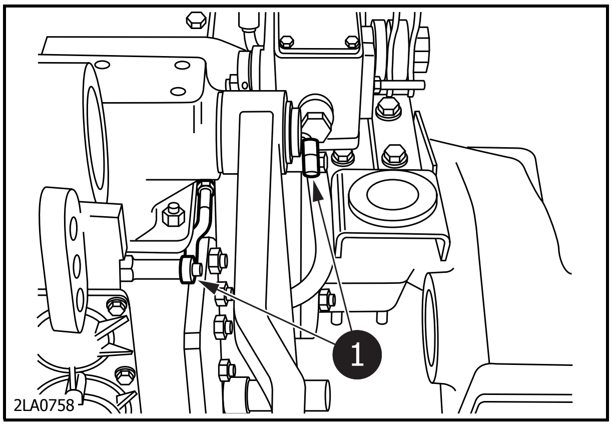
1. Fix the gearbox-transmission housing to a fixed stand.

2. Unscrew the fixing screws (1) and remove the gear lever assembly (2).



12

3. Detach the power lift valve gear transmission rods (1).



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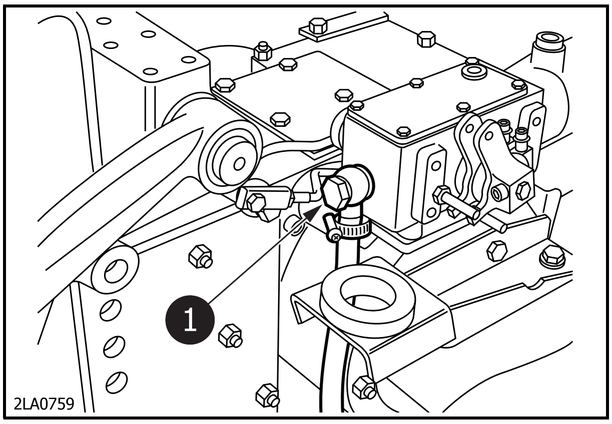
4. Unscrew the hydraulic hose union (1) of the valve system.



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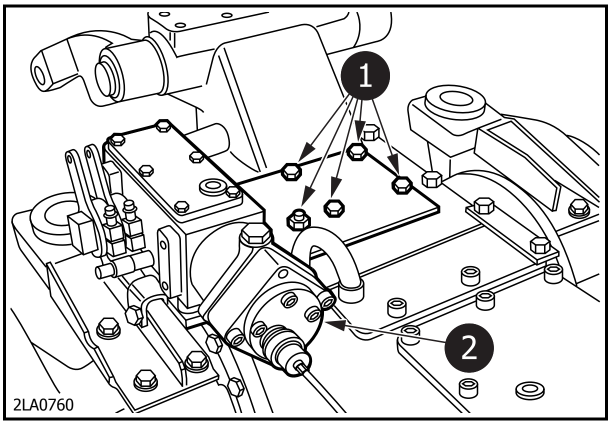
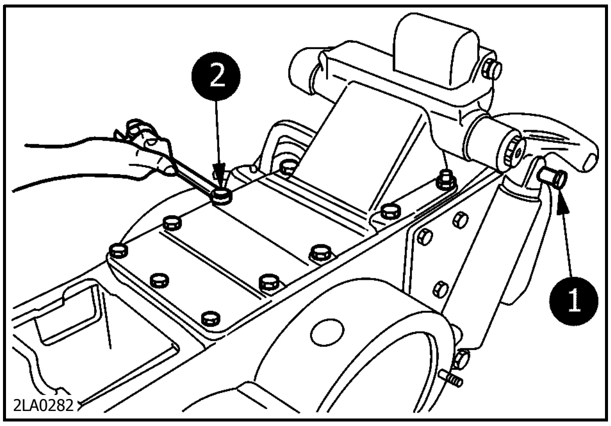
5. Unscrew the fixing screws (1) and remove the valve system (2) of the power lift.



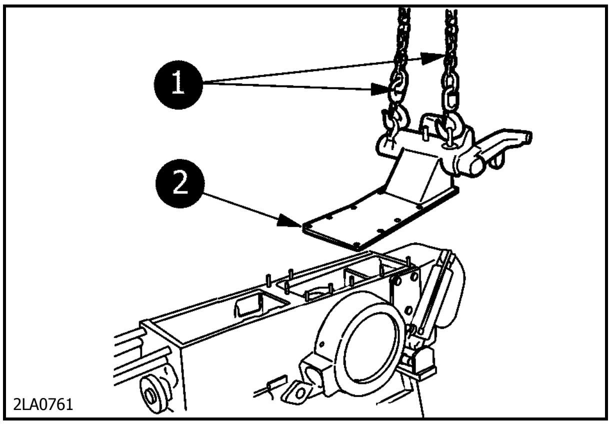
15

6. Take out the pin (1) that connects the cylinders to the lifting links. Unscrew the bolt (2) that fixes the power lift cover.



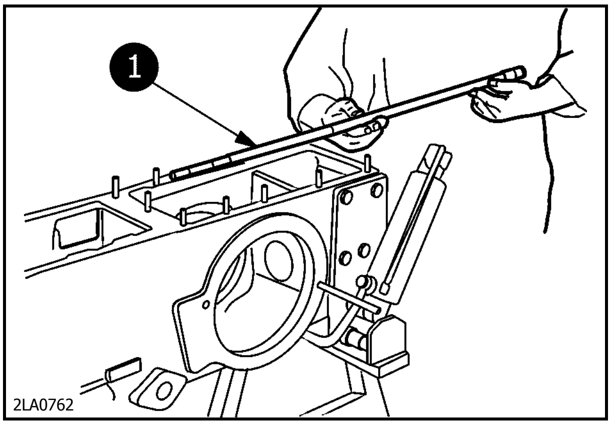
16

7. Fix the hoist chains (1) to the power lift cover (2) and remove it.



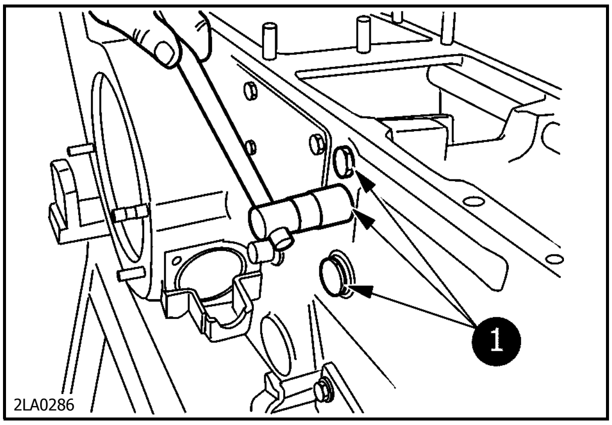
17

8. Remove the control shaft of the rear PTO (1).



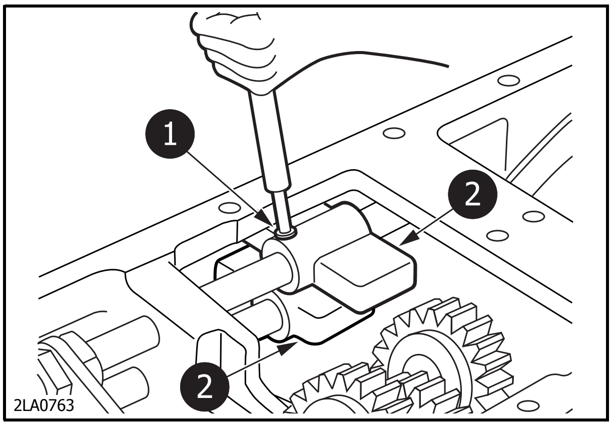
18

9. Unscrew the closing plugs (1) and recover the retainer balls and springs of the rods.



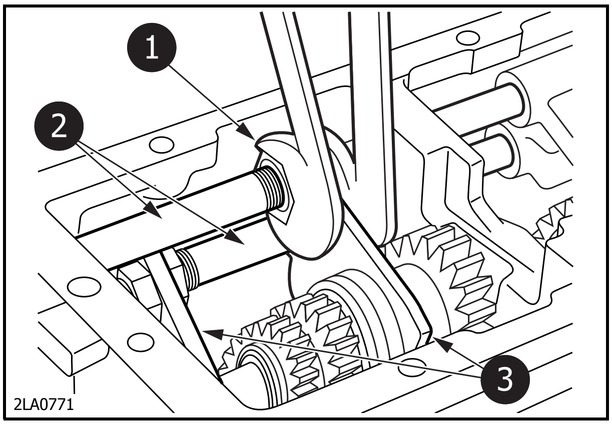
19

10. Using a pin driver, remove the spring pins (1) that hold the gear engaging forks (2) in place.



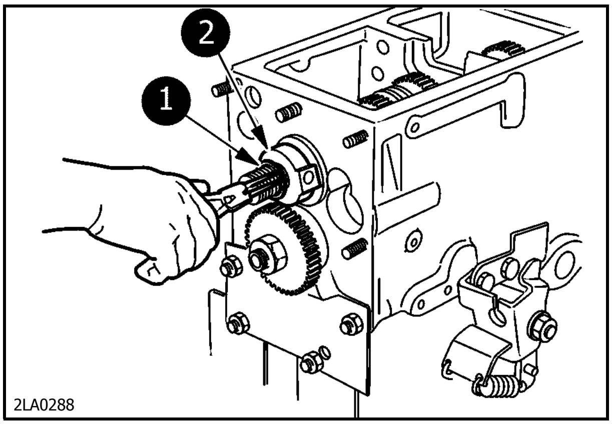
20

11. Unscrew the lock nuts (1), take out the rods (2) and recover the synchromesh forks (3).



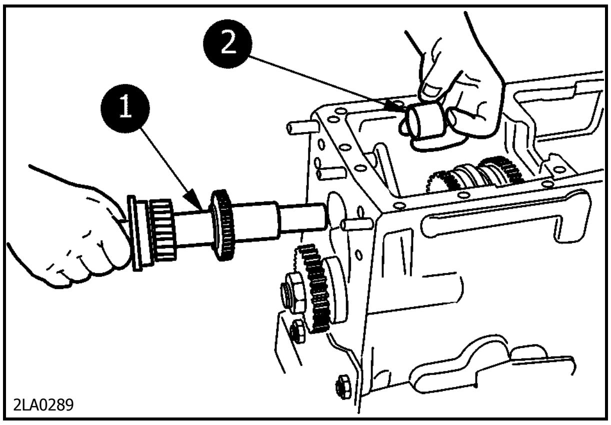
21

12. Remove the spring ring (1) of the main shaft. Remove the lubrication collar (2) and recover the spacer and adjuster shims.



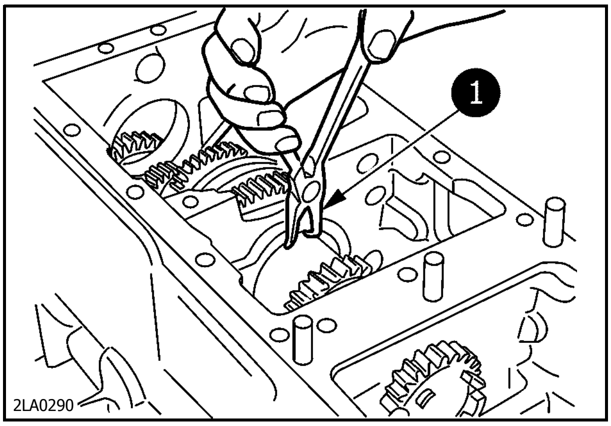
22

13. Take out the front part of the main shaft (1) and recover the bronze bush (2).



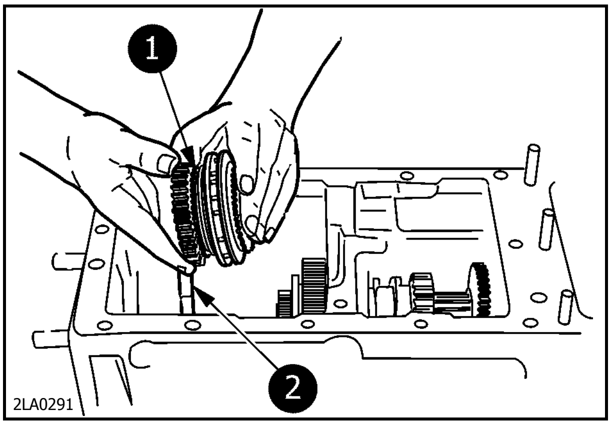
23

14. Remove the spring ring (1) that holds the upper shaft.



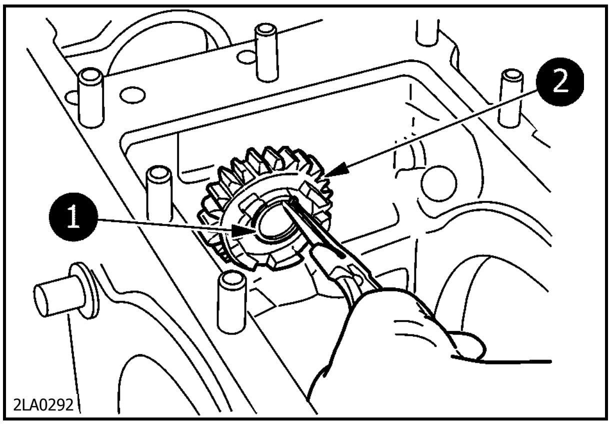
24

15. Retract the upper shaft, recover the synchromesh (1) of the 3rd and 4th gear and the engaging fork (2) of the 1st and 2nd gear.



25

16. Remove the spring ring (1) and take out the PTO gear (2). Recover the washer and bearing.



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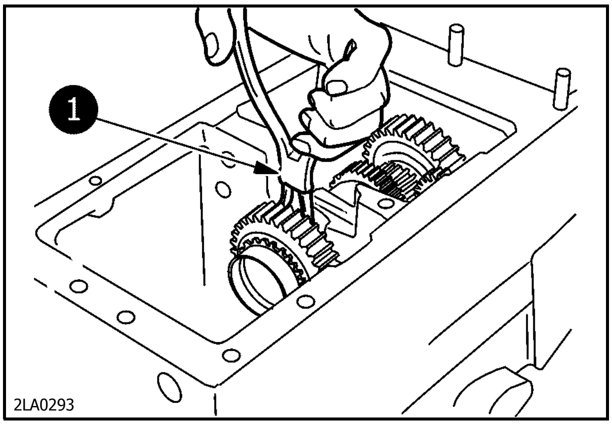
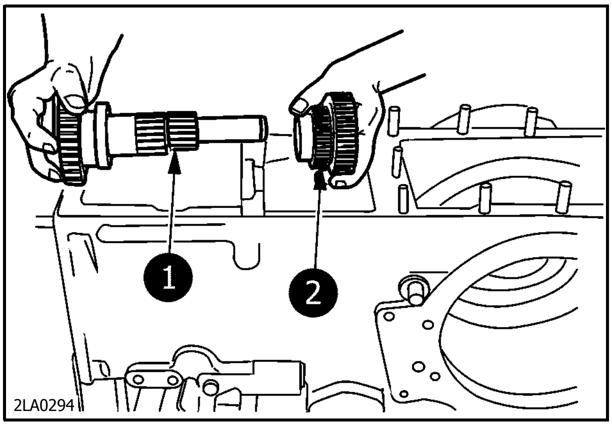
17. Remove the front spring ring (1).



27

18. Take out the rear part of the main shaft (1) and recover its components (2).



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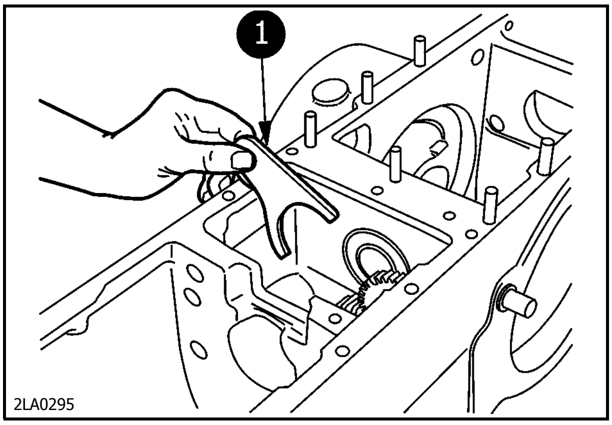
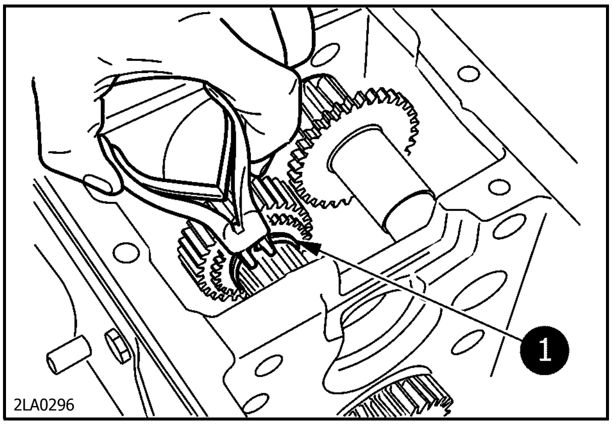
19. Recover the fork (1) that engages the ranges.



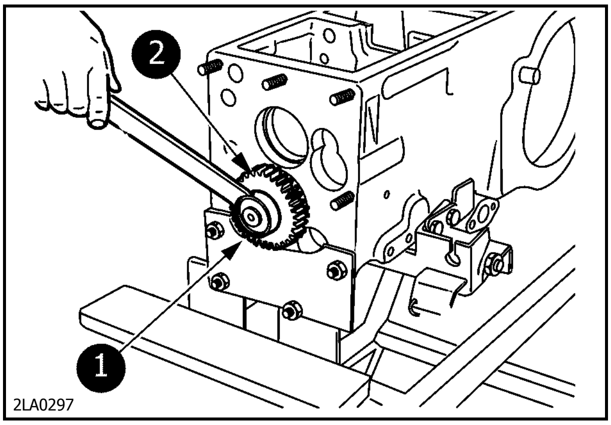
29

20. Remove the spring ring (1) that holds the driven gear of the ranges.



30

21. Unscrew the pinion locking nut (1) and remove the gear (2).



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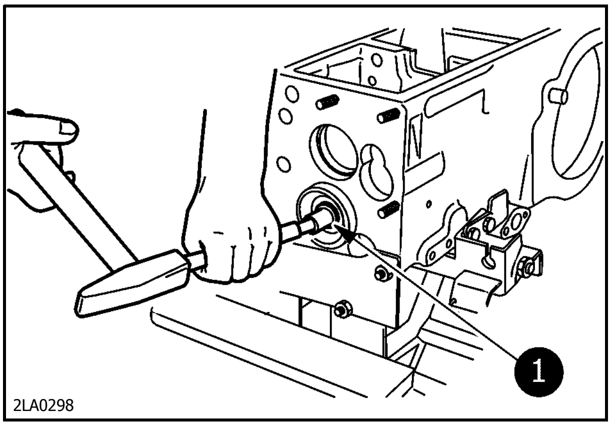
22. Push the pinion (1) towards the rear part of the gearbox-transmission housing using an adequate tool.



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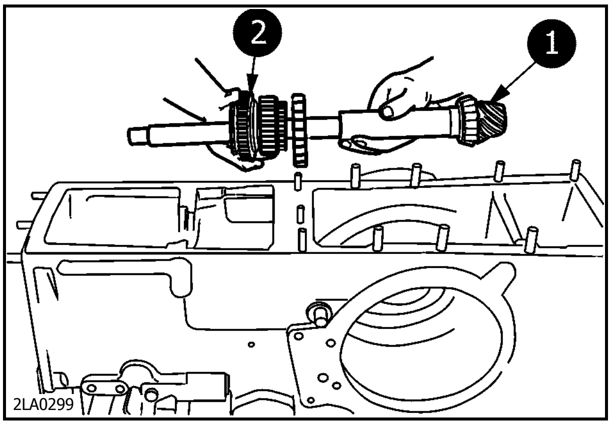
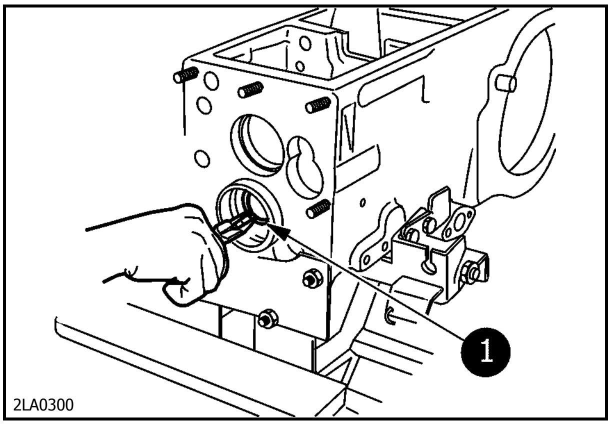
23. Take out the pinion (1) and recover the speed range gears (2).



33

24. Remove the spring ring (1) that holds the 1st and 2nd gear synchromesh.



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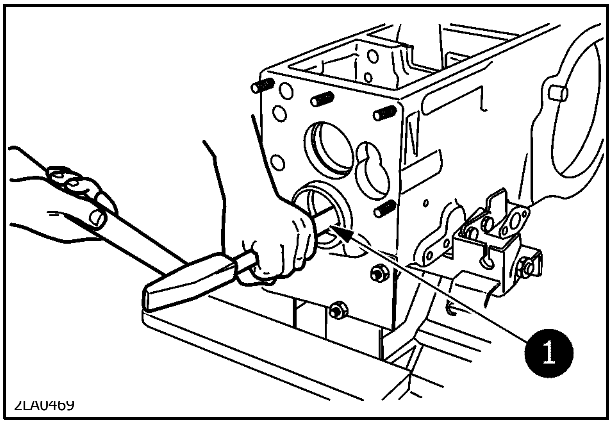
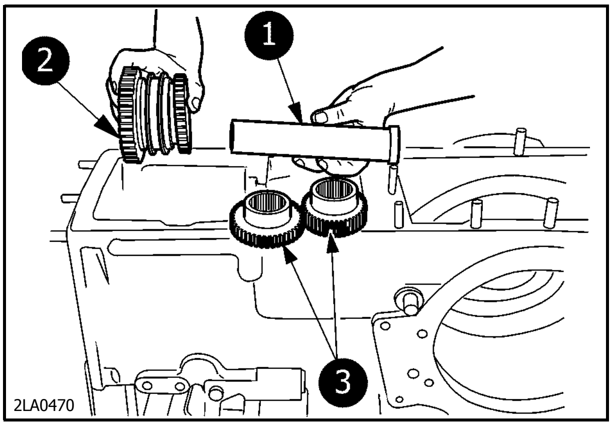
25. Push the transmission shaft (1) towards the rear part of the gearbox-transmission housing using an adequate tool.



35

26. Remove the transmission shaft (1) and recover the 1st and 2nd speed gears (3) and synchromesh.



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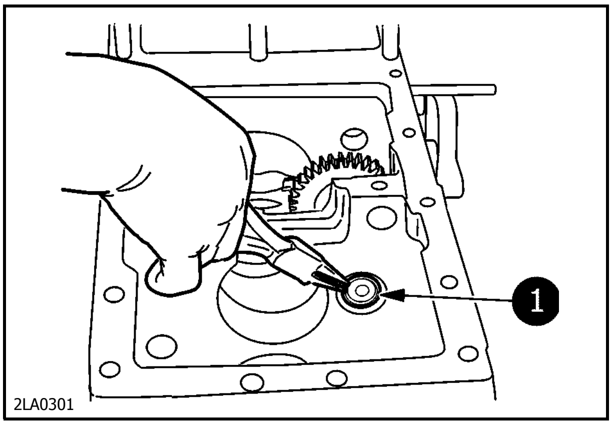
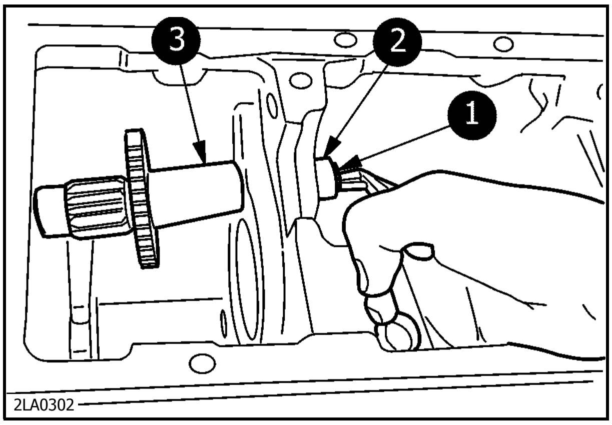
27. Remove the spring ring (1) that holds the transmission gear of the slow ranges.



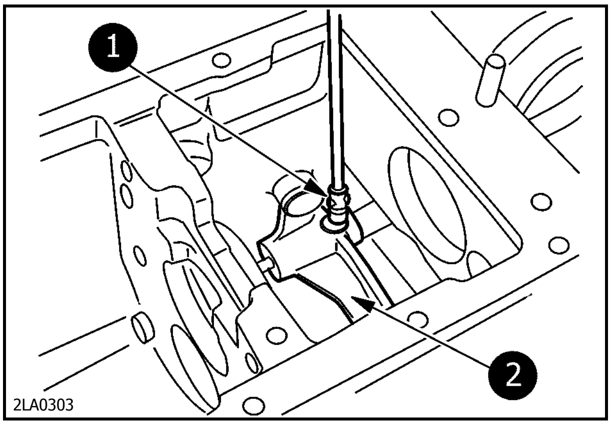
37

28. Retract the gear (3) in order to remove the spring ring (1) that holds the bearing in place. Take out the bearing (2) and recover the slow speed range transmission gear.



38

29. Unscrew the locking bolt (1) of the supplementary final drive engaging fork (2).



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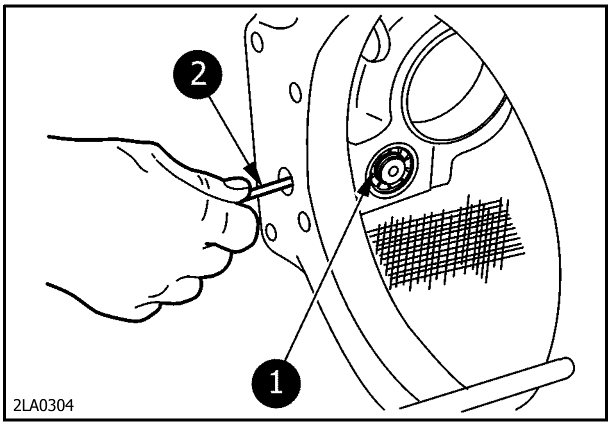
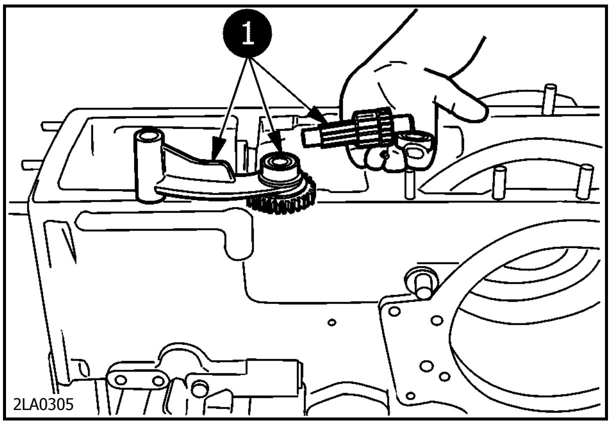
30. Remove the spring ring (1) that holds the shaft that supports the supplementary final drive gear and unscrew the retention screw (2) of the rear bearings.



40

31. Remove all the supplementary final drive components (1) from the gearbox-transmission housing.



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Assembly

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Comply with the following recommendations when remounting the gearbox-transmission housing:

- Consult figures 2 and 3 in order to position the various parts correctly.
- Before remounting the housings, supports and covers, thoroughly clean and degrease the coupling surfaces and apply a strip of sealant about 2 mm in diameter as indicated in figure 4.
- Apply the driving torques listed on page 4.
- Mount the supplementary final drive components and relative engaging fork.
- Mount the transmission gear of the slow speed ranges along with the relative spring retention rings.
- Mount the transmission shaft, 1st and 2nd speed synchromesh and the relative gears.
- Mount the pinion with the speed gears.
- Lock the pinion nut (see Section 500, Bevel gear pair adjustments, for the relative adjustments required).
- Mount the spring ring that holds the driven gear of the ranges.
  Position the fork that engages the ranges.
- Mount the rear part of the main shaft along with the relative components and the front spring ring.
- Mount the PTO gear with the washer, the bearing and spring ring.
- Mount the 3rd and 4th speed synchromesh and the engaging fork of the 1st and 2nd gear.
- Mount the spring ring of the upper shaft.
- Mount the front part of the main shaft with the relative bronze bush.
- Mount the adjuster shims, the spacer, the lubrication collar and the spring ring of the main shaft.
- Mount the rods with the relative control forks.
- Mount the closing plugs with the retainer balls and springs of the rods.

- Mount the shaft of the rear PTO drive.
- Position and fix the cover of the power lift.
- Connect the cylinders to the lifting links, using the relative connection plugs.
- Position and fix the valve system to the gearbox transmission housing.
- Connect the hydraulic hose of the valve system.
- Connect the power lift valve gear transmission rods.
- Remove the gearbox-transmission housing from the stand.

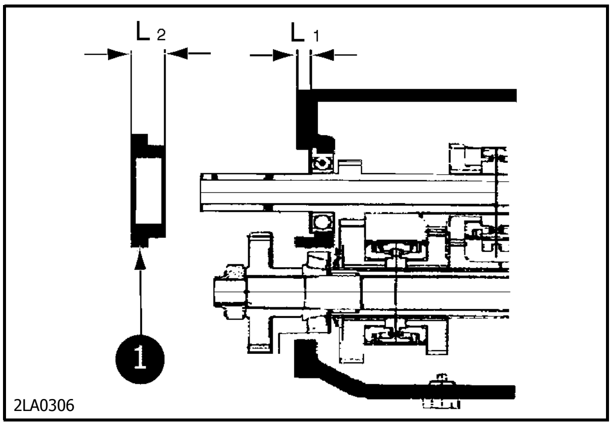
Main shaft float adjustment

WARNING
Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Make sure that, once mounted, the main shaft has a 0.1 mm float to ensure that it operates correctly.

Proceed as follows:

1. Using a depth micrometer, measure dimension (L_1) between the bearing and the front plane of the gearbox-transmission housing.
2. Measure thickness (L_2) of the spacer (1) with a micrometer.



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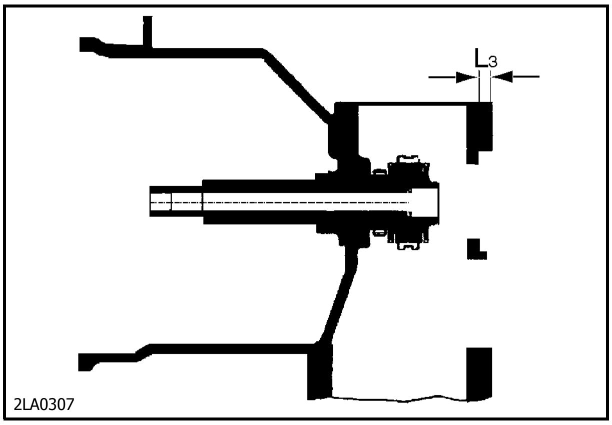
3. Using a depth micrometer, measure depth (L_3) of the seat of the spacer on the clutch housing.



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4. The adjuster shim (Sh_2, page 5) to mount on the main shaft will be given by:
   $Sh_2 = (L_1 + L_3 + 0.1) - L_2$
   where
   L_1 = dimension measured
   L_2 = dimension measured
   L_3 = dimension measured
   0.1 = operating play of the main shaft.
   Round off to the lower figure.

Reverse shuttle gear float adjustment

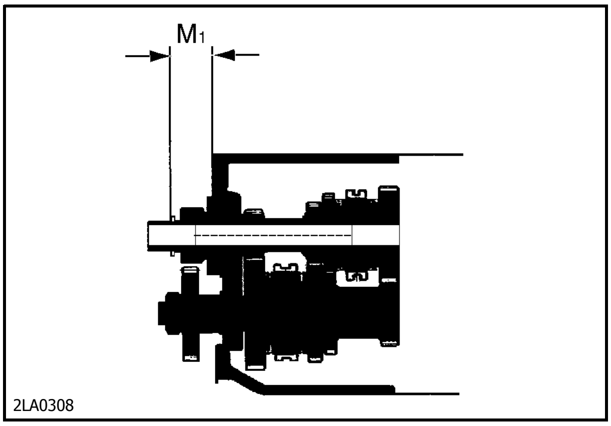
WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Once mounted, the reverse shuttle gear must have a 0.3 - 0.4 mm float to ensure that it operates correctly.

Proceed as follows:

1. Using a depth micrometer, measure dimension (M_1) between the front plane of the gearbox-transmission housing and the spring ring mounted on the main shaft.



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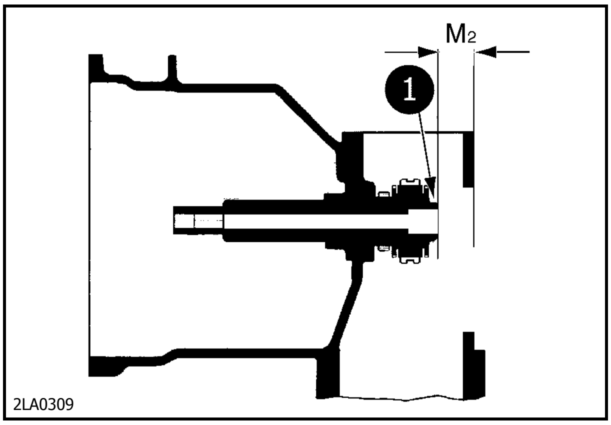
2. Using a depth micrometer, measure dimension (M_2) between the rear plane of the clutch housing and the reverse shuttle gear (1).



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3. The adjuster shim (Sh_1, page 4) to mount on the main shaft and the reverse shuttle gear will be given by:

$\mathbf{Sh_1 = M_2 + (0.3 - 0.4) - M_1}$

where

$\mathbf{M_1}$ = dimension measured

$\mathbf{M_2}$ = dimension measured

0.3 - 0.4 = operating play of the synchromesh gear.

Round off to the lower figure.

CLUTCH HOUSING - OVERHAUL

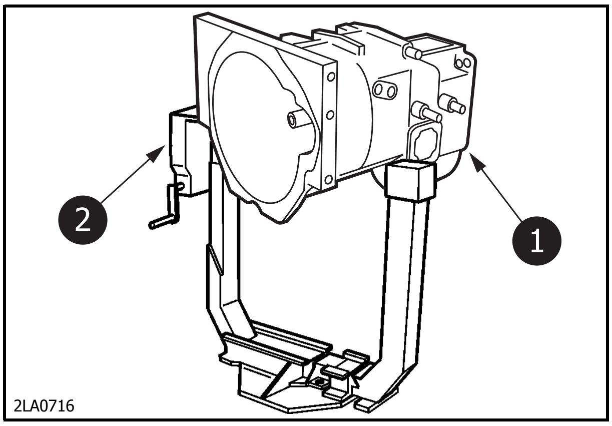
Demounting

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

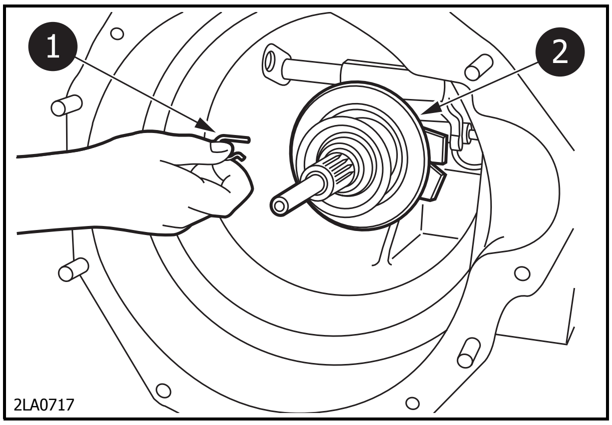
Proceed as follows:

1. Split the gearbox-transmission housing.
2. Fix the clutch housing to a rotating stand.



46

3. Remove the retention springs (1) of the thrust bearing (2).



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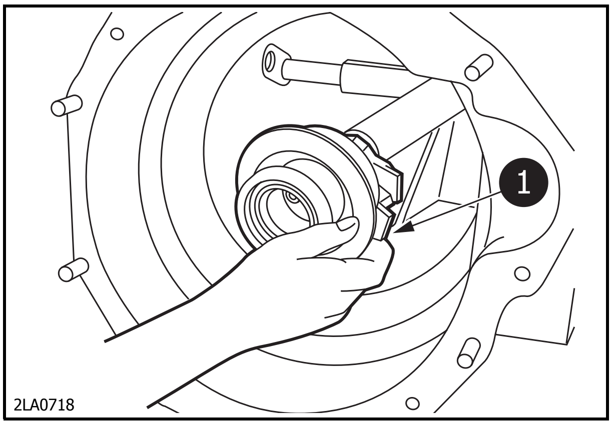
4. Remove the thrust bearing (1).



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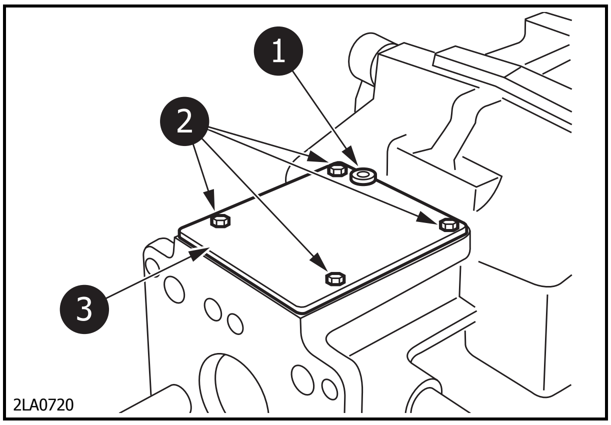
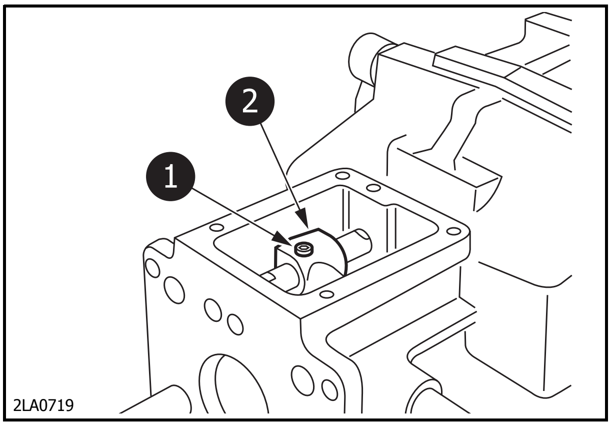
5. Unscrew the locking plug (1) and the fixing screws (2), and remove the cover (3).



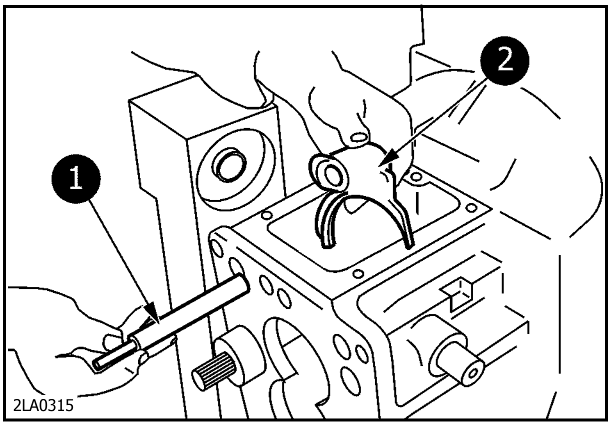
49

6. Unscrew the locking screw (1) of the reverse shuttle engaging fork (2).



50

7. Take out the rod (1) and recover the engaging fork (2).



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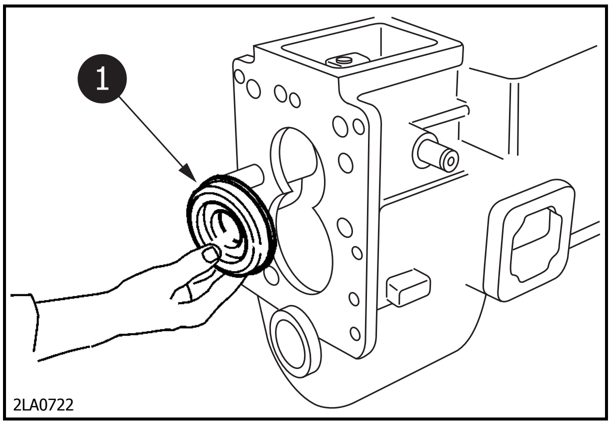
8. Remove the reverse shuttle synchromesh (1).



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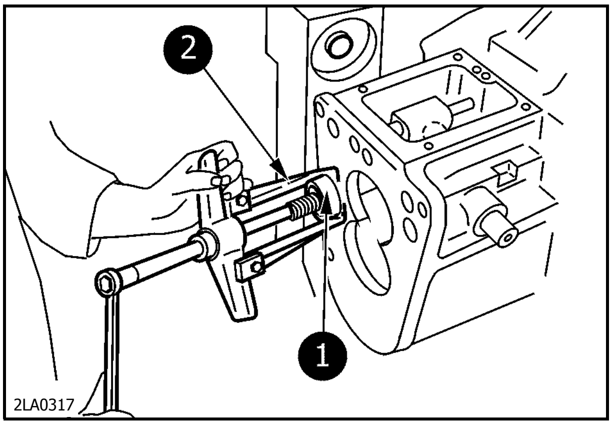
9. Remove the bearing (1) using a puller (2).



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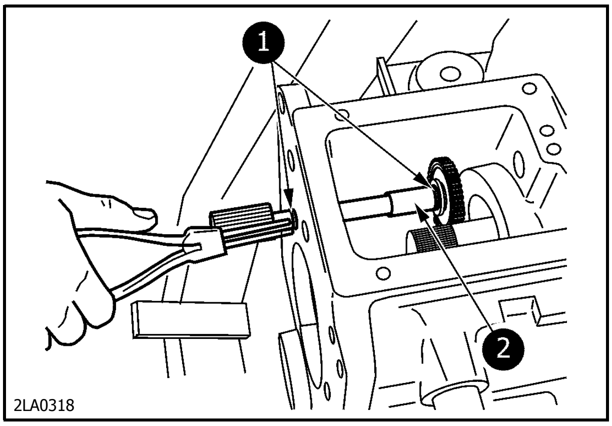
10. Remove the front and rear spring rings (1) of the reverse shaft.



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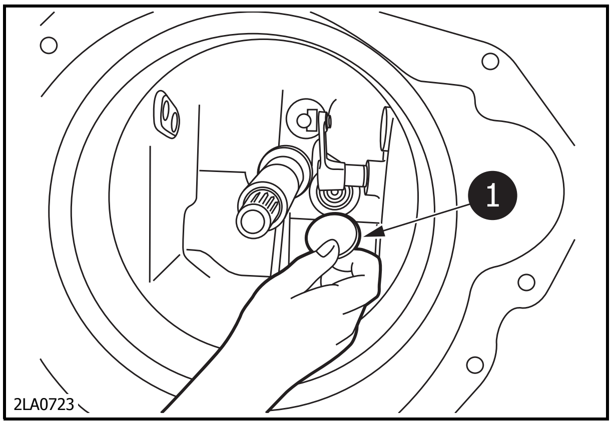
11. Remove the sealing plug (1) by levering with a suitable tool.



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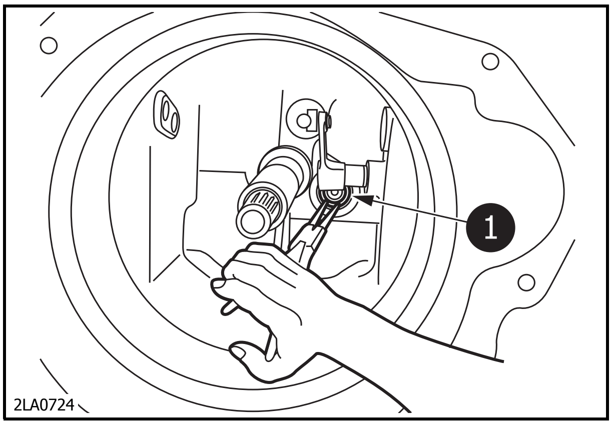
12. Remove the spring ring (1) that holds the bearing of the reverse shaft.



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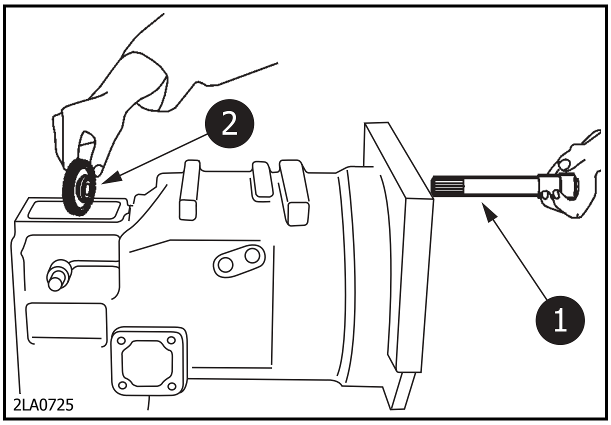
13. Remove the reverse shaft (1) and recover the gear (2).



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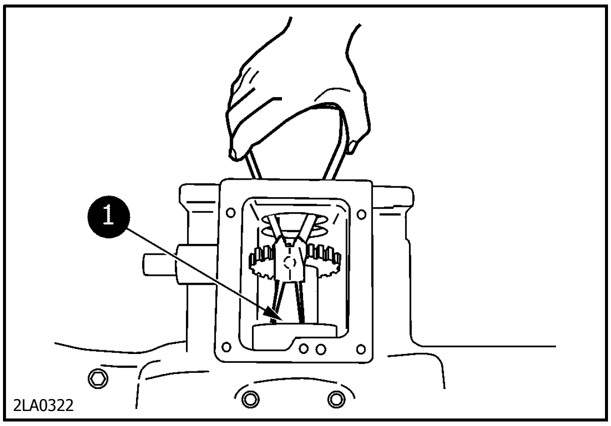
14. Remove the spring ring (1) that holds the driven shaft.



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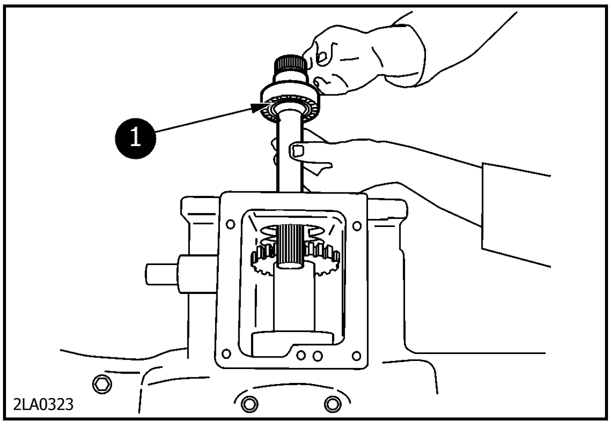
15. Remove the driven shaft (1) complete with the relative bearing.



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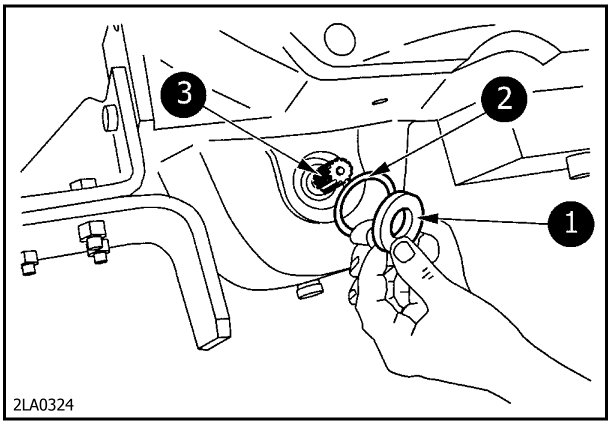
16. Remove the retention ring (1) by levering with a suitable tool. Remove the spring ring (1) that holds the PTO shaft and allow the shaft itself to move forward, using a suitable tool.



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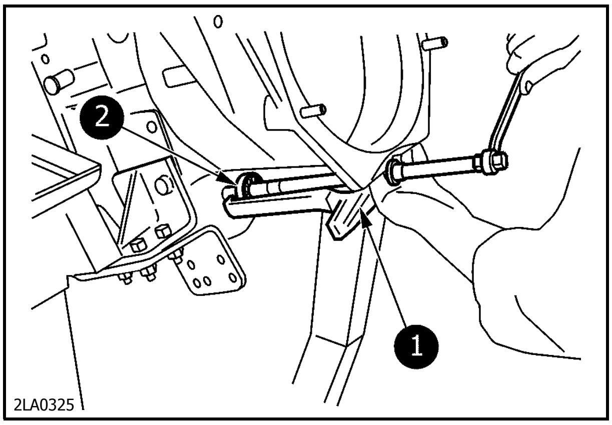
17. Remove the bearing (2) of the 4WD shaft using a puller (1).



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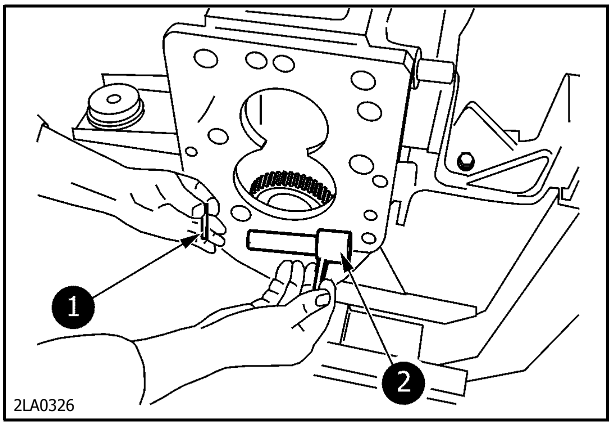
18. Remove the spring ring (1) and take the 4WD engaging lever (2) out of the clutch housing.



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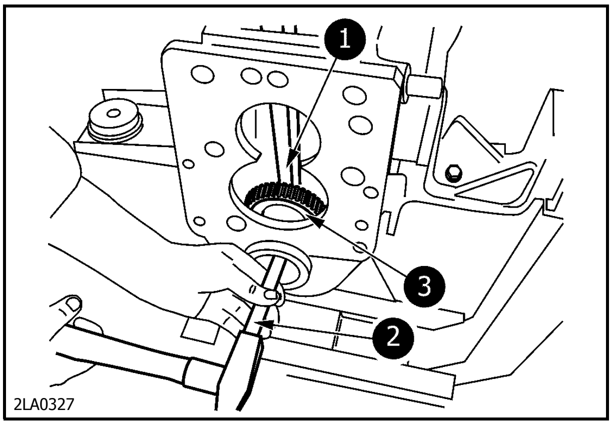
19. Use an aluminium bar (1) to oppose the movement of the gear (3). Remove the 4WD shaft and the relative gear (3) with a suitable tool (2).



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Assembly

Remount the clutch housing bearing the following recommendations in mind:

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

- Consult figures 2 and 3 in order to position the various parts correctly.
- Mount the 4WD shaft and the relative gear.
- Insert the 4WD engaging lever and lock it in place with the relative spring ring.
- Mount the bearing of the 4WD shaft.
- Mount the driven shaft with the relative bearing and spring retention ring.
- Mount the reverse shaft with the relative gear and spring retention ring.
- Mount a new retention plug.
- Mount the front bearing of the reverse gear along with the relative spring retention rings.
- Insert the reverse shuttle synchromesh.
- Mount the engaging fork of the reverse shuttle, lock the sliding rod and insert the retention plugs.
- Mount the thrust bearing with the relative retention springs.
- Remove the housing from the rotating stand.
- Remount the gearbox-transmission housing.

SECTION 500

REAR DIFFERENTIAL AXLE

INDEX

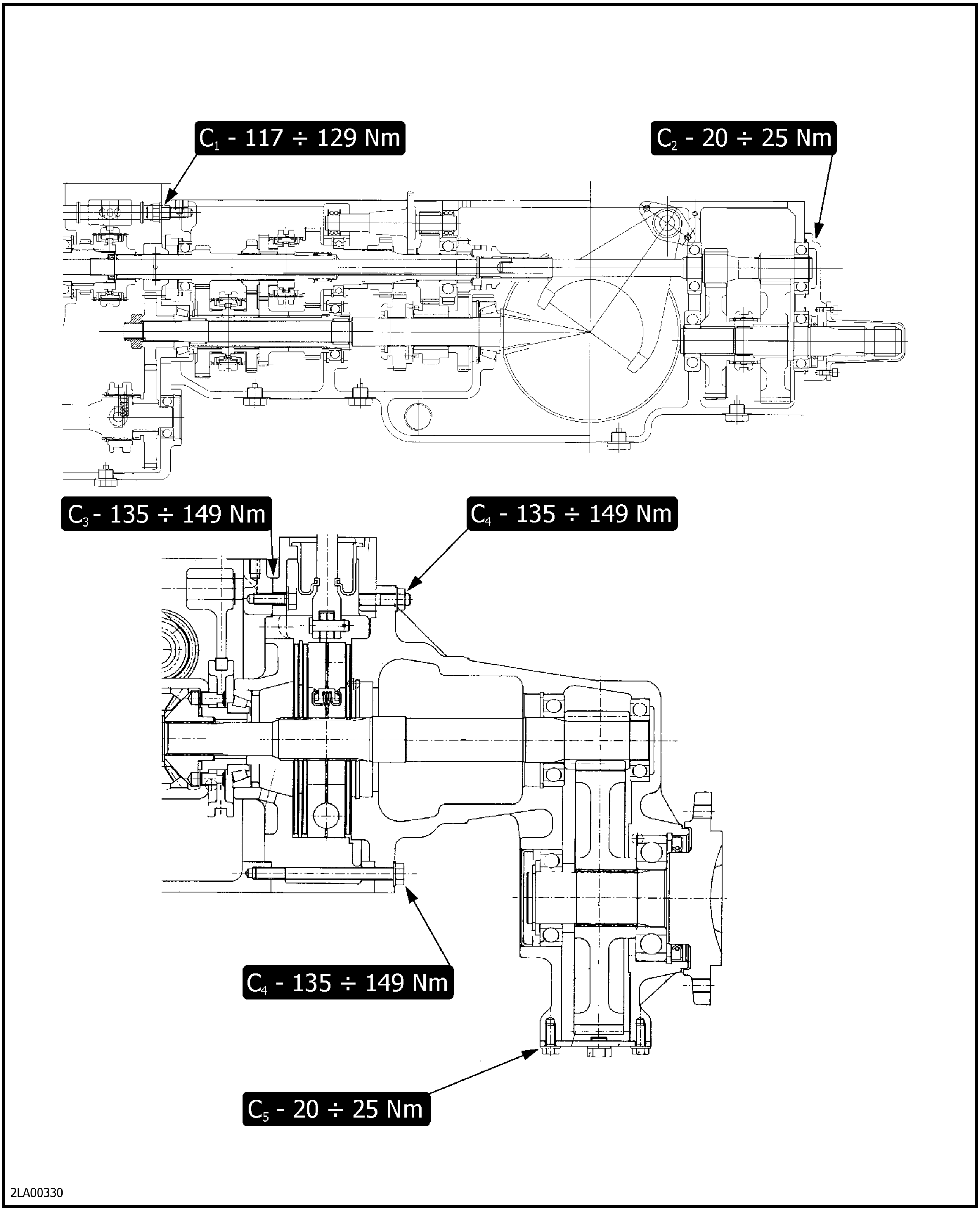
MAIN SPECIFICATIONS OF THE BEVEL GEAR PAIR AND DIFFERENTIAL

Bevel gear pair gear ratio:	9/44 = 1:4.88
Play between the flanks of the bevel gear pair gear teeth (mm)	0.15 – 0.22
Type of differential	with two planetaries
Mechanical control of diff lock	Electrohydraulic with mechanical engagement
Adjustment of the bevel gear pair bearings and bevel gear pair meshing play	see pages 20 – 26.
Thickness of the bearing adjuster rings and bevel gear pair meshing play (S_d, S_s, fig. 2) (mm)	0.70 – 0.75 – 0.80 – 0.85 – 0.90 – 0.95 – 1.00 – 1.10
Thickness of the pinion bearing adjuster rings (Sh_1, fig. 2) (mm)	0.10 – 0.30 – 0.50 – 0.70 – 0.90 – 1.10 – 1.30 – 1.50

DRIVING TORQUE VALUES

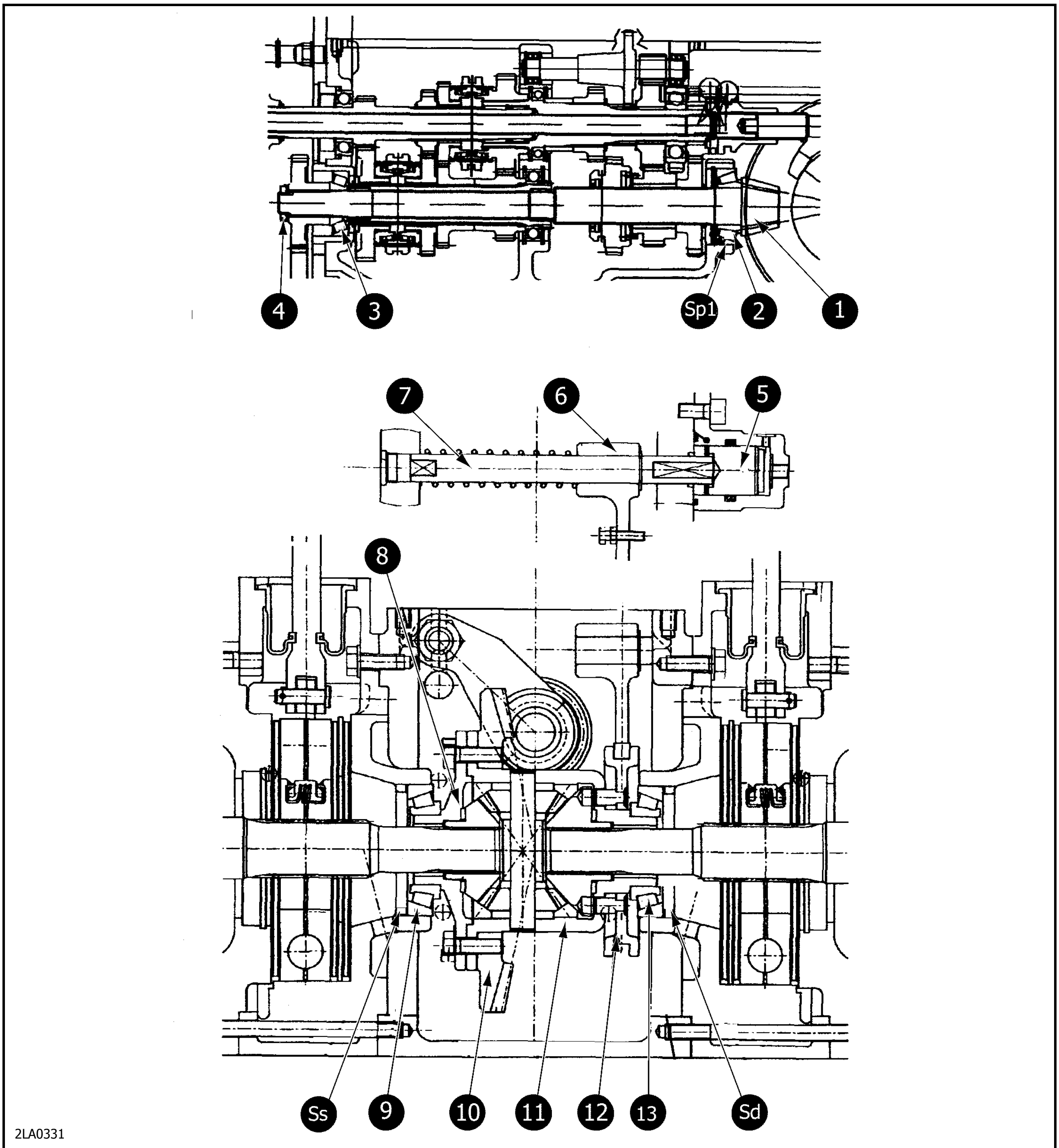
PARTS TO TORQUE	Thread	Driving torque values	
		Nm	kgm
Screws fixing transmission housing to clutch housing (C_1)	-	117 - 129	11.9 - 13
Screw fixing cover to transmission housing PTO (C_2)	-	20 - 25	2 – 2.5
Screw fixing bevel gear pair bearing support (C_3)	-	135 - 149	13.8 – 15.2
Screw fixing transmission housing-final drive housing (C_4).	-	135 - 149	13.8 – 15.2
Screw fixing side final drive cover (C_5).	-	20 - 25	2 – 2.5

DRIVING TORQUE VALUES



1

SECTIONS

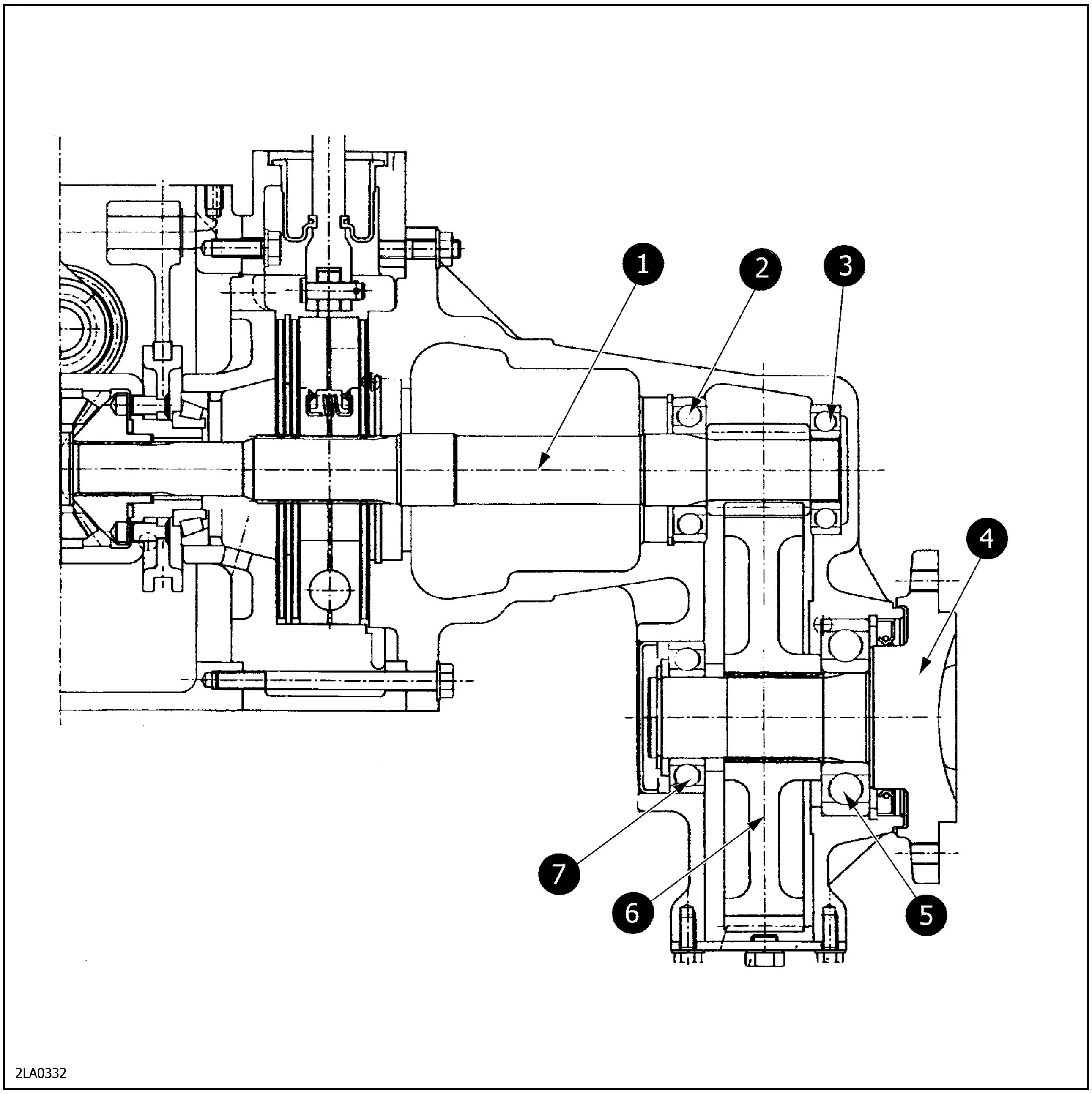


2

Rear transmission-gearbox sections

- S_d Adjuster shims.
- S_{p1} Adjuster shims.
- S_s Adjuster shims.
- **1.** Bevel pinion.
- **2.** Taper bearing.
- **3.** Taper bearing.
- **4.** Nut
- **5.** Diff lock hydraulic actuator.
- **6.** Diff lock fork.
- **7.** Diff lock rod.
- **8.** Flange.
- **9.** Taper bearing.
- **10.** Bevel ring gear.
- **11.** Differential housing.
- **12.** Diff lock ring.
- **13.** Taper bearing.

SECTIONS



3

Side final drive sections

1. Axle shaft.
2. Ball bearing.
3. Ball bearing.
4. Wheel hub.
5. Ball bearing.
6. Final drive gear.
7. Ball bearing.

DESCRIPTION AND OPERATION.

The rear transmission transmits drive from the gearbox to the side final drives, by means of the bevel gear pair. The bevel gear pair is the type with helical toothing and is supported by taper roller bearings.

The differential has two planetaries and is provided with a mechanically engaged, electrohydraulically engaged diff lock.

The side final drives are the type with straight toothing and are controlled by the bevel gear pair output axle shaft, the same that control the main brakes.

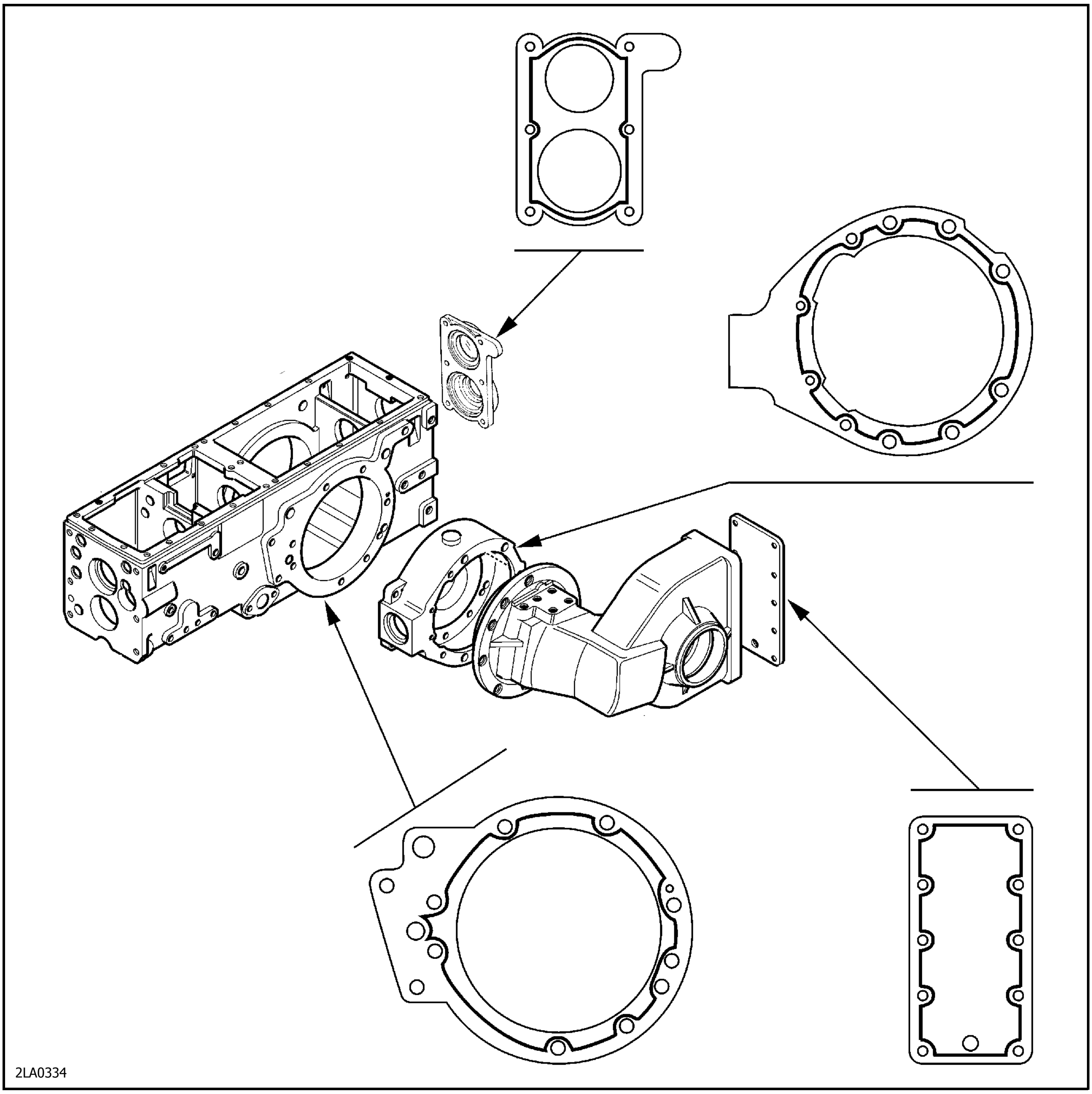
TROUBLESHOOTING FOR THE BEVEL GEAR PAIR AND DIFFERENTIAL

Faults	Possible causes	Remedies
Noisy transmission when the tractor is on the move, even with the gears in neutral (not due to the side final drives).	**1.** Crown wheels and planetary gears incorrectly adjusted or worn.	Detach the rear transmission housing, replace the worn parts and correctly adjust the differential gears.
	2. Excessive play in the groove where the axle shafts are shrunk on to the crown wheels.	Remove the rear transmission housing and replace the damaged parts.
Noisy transmission when the tractor is on load and without load.	**1.** Some internal component is faulty or defective.	Detach the rear transmission housing, replace the worn parts and correctly adjust the differential gear play.
Noisy transmission with overheating.	**2.** Insufficient coupling play between the pinion teeth and bevel gear pair.	Remove the rear transmission housing and correctly adjust the bearings that support the ring bevel gear.

TROUBLESHOOTING FOR THE SIDE FINAL DRIVES

Faults	Possible causes	Remedies
Noisy side final drives when the tractor is on the move, even with the gears in neutral.	**1.** Some internal component is faulty or defective.	Remove the side final drive housing and replace the damaged parts.
	2. Excessive play in the groove where the wheel axle shafts are shrunk on to the side final drives.	Remove the side final drive housing and replace the damaged parts.

WHERE THE SEALANT IS APPLIED FOR THE GEARBOX-REAR TRANSMISSION HOUSING



4

The types of sealant to apply are indicated in section 100.

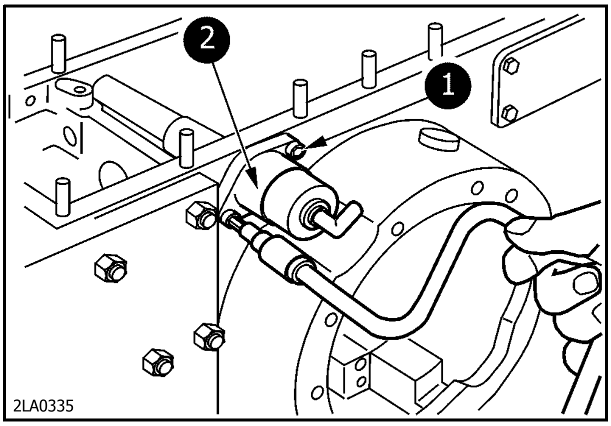
REAR TRANSMISSION HOUSING - OVERHAUL

Demounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

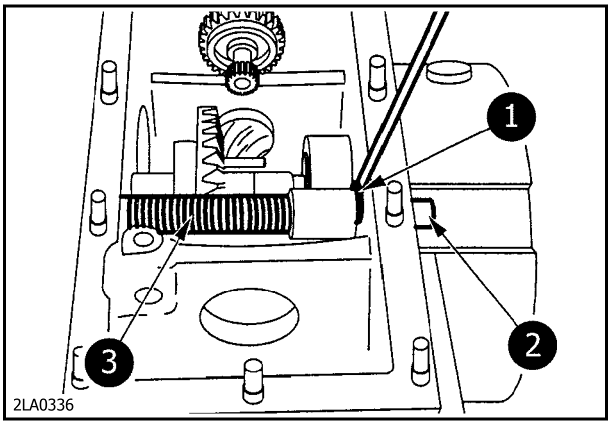
Proceed in the following way to demount the parts:

1. Split the gearbox-rear transmission housing (see section 400).
2. Split the mechanically engaged PTO (see section 600).
3. Unscrew the fixing screws (1) and remove the diff lock actuator (2).



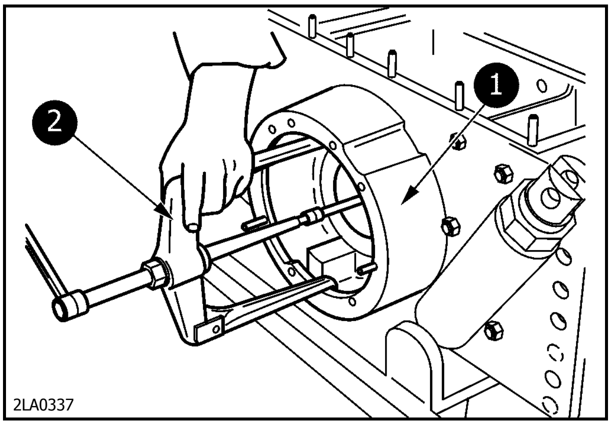
5

4. Remove the spring ring (1) and take out the diff lock rod (2). Recover the fork and return spring (3) from inside the transmission housing.



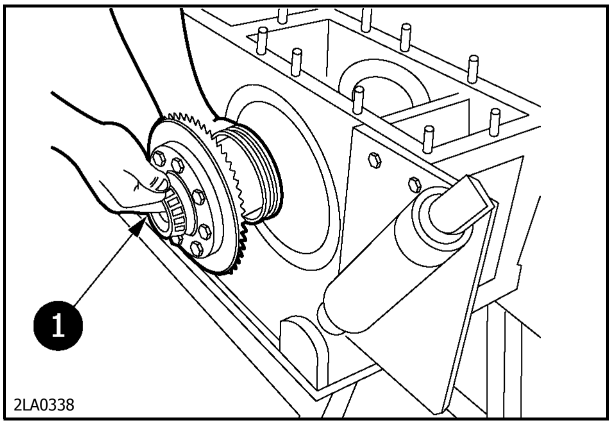
6

5. Unscrew the fixing bolts (1) of the left-hand support of the ring bevel gear (1) and remove it.
   Use and adequate puller (2) for this operation.



7

6. Remove the ring bevel gear (1) from the gearbox-rear transmission housing and recover the adjuster shims.



8

Assembly

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Comply with the following recommendations when remounting the gearbox-transmission housing.

- Consult the illustrations on pages 7 and 8 in order to position the various parts correctly.
- Before remounting the housings, supports and covers, thoroughly clean and degrease the coupling surfaces and apply a strip of sealant about 2 mm in diameter as indicated in figure 4.
- Apply the driving torques listed on page 4.
- Adjust the pinion bearings as described on page 21.
- Position the ring bevel gear inside the transmission housing. Mount the left-hand ring bevel gear support.
- Adjust the ring bevel gear bearings and the play between the flanks of the bevel gear pair teeth as described on page 21.
- Mount the diff lock rod complete with fork and return spring.
- Mount the diff lock hydraulic actuator.

RIGHT OR LEFT SIDE FINAL DRIVE HOUSING-ASSEMBLY SPLITTING REMOUNTING

Splitting

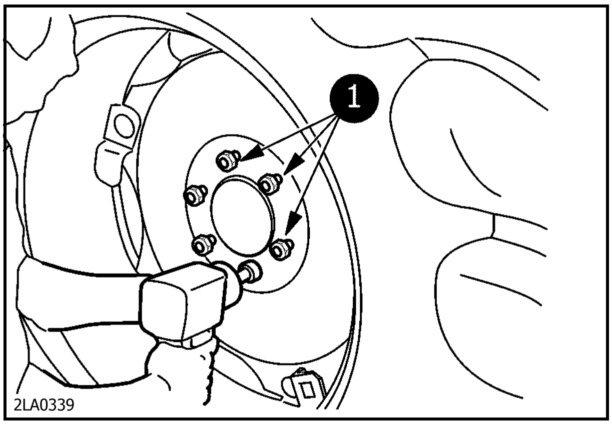
> **DANGER**
> Lift and handle all heavy parts with lifting equipment of an adequate capacity.
> Make sure that the units or parts are supported by appropriately sized harness and hooks.
> Make sure that there are no bystanders near the load being lifted.

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

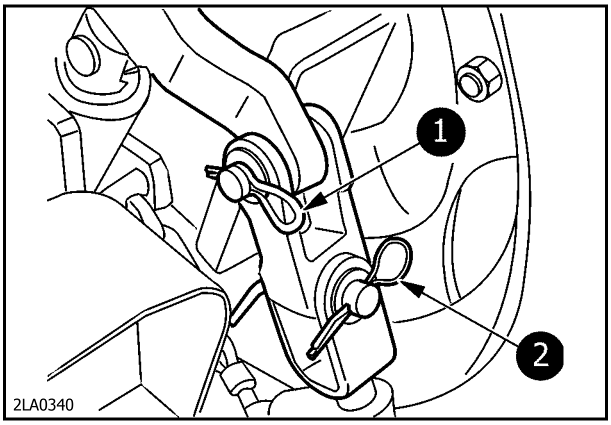
- Block the front wheels with chocks.
- Jack up the rear part of the tractor.

1. Unscrew the fixing bolts (1) and remove the wheel.



9

2. Remove the pin (1) that fixes the connecting plug of the stay that prevents side swing (2) and take out the plug.



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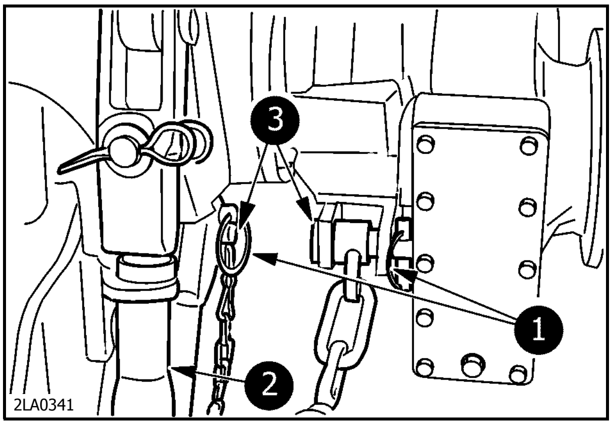
3. Remove the pins (1) that fix the connecting plugs of the stay that prevents side swing (2) and take the plugs (3) out of their relative housings.



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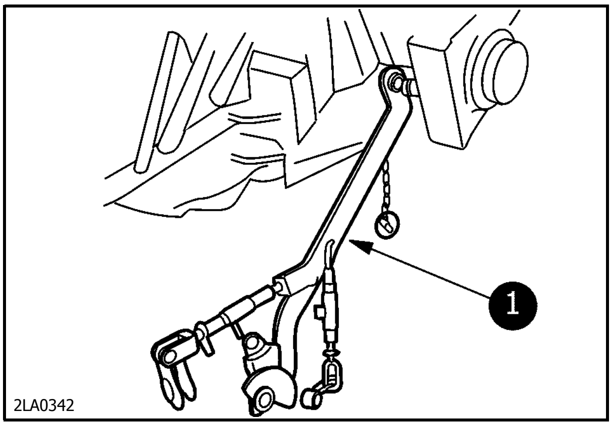
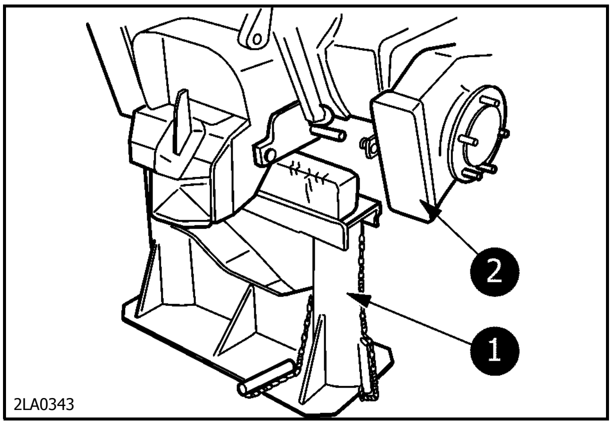
4. Disconnect the anti-side swing stay (1).



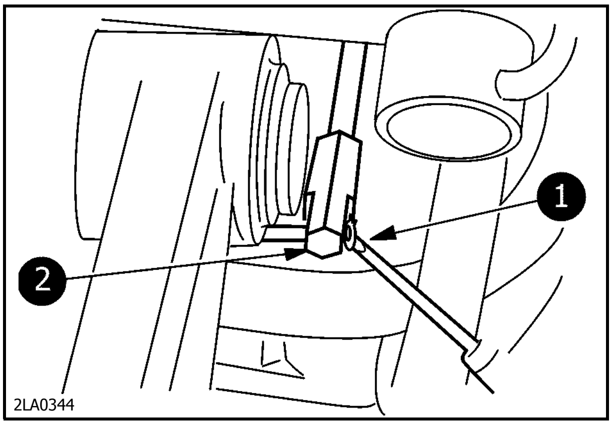
12

5. Position a mechanical stand (1) under the rear transmission (2), inserting a strip of wood between the tractor and the actual stand itself. Drain the oil from the transmission.



13

6. Remove the spring ring (1) anddisconnect the power lift rod (2).



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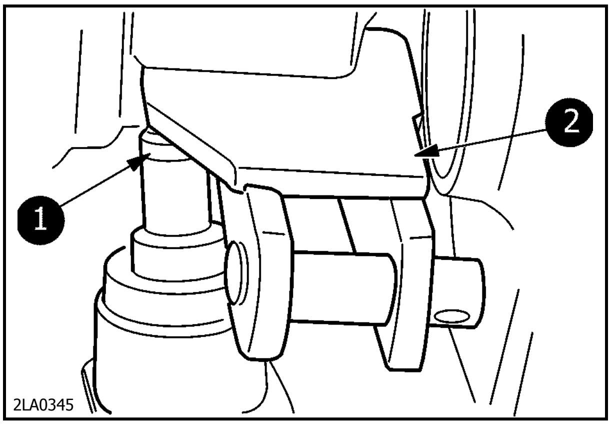
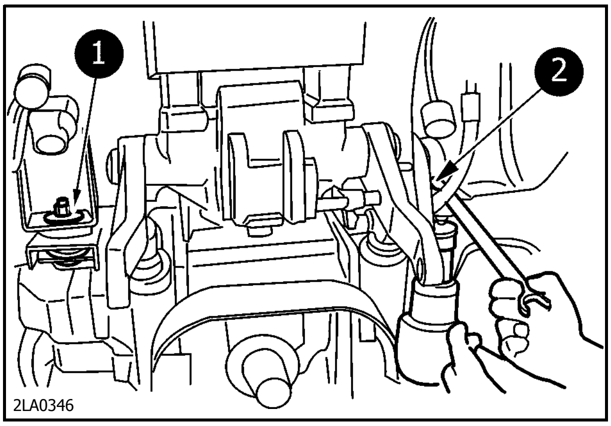
7. Using the tool (1), unscrew the fixing screws and disconnect the support that fixes the anti-side swing chain (2).



15

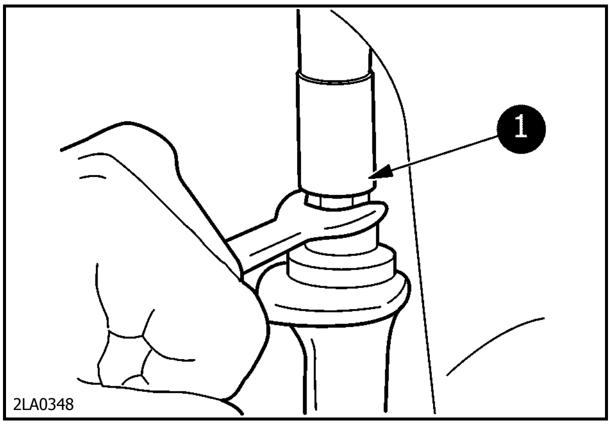
8. Unscrew the fixing bolts (1) of the platform.



16

9. Disconnect the hydraulic oil hose (1).

> Old oil must be disposed of in compliance with the current laws in merit.



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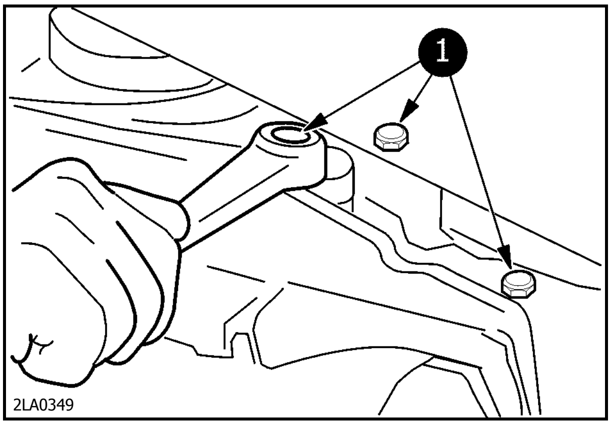
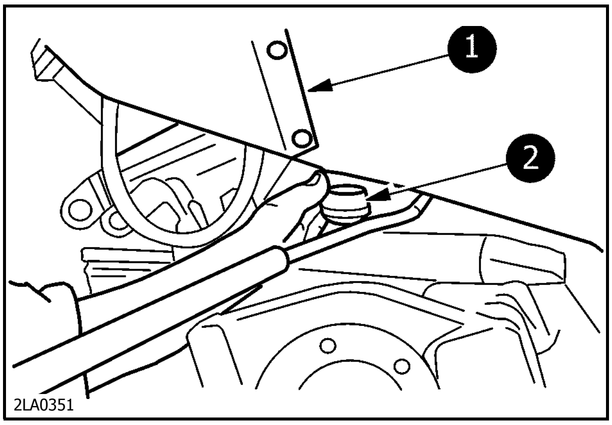
10. Using a standard spanner, unscrew the three accessible fixing bolts (1) of the platform support.



18

11. Using a suitable tool, raise the mudguard (1) and remove the rubber support (2).



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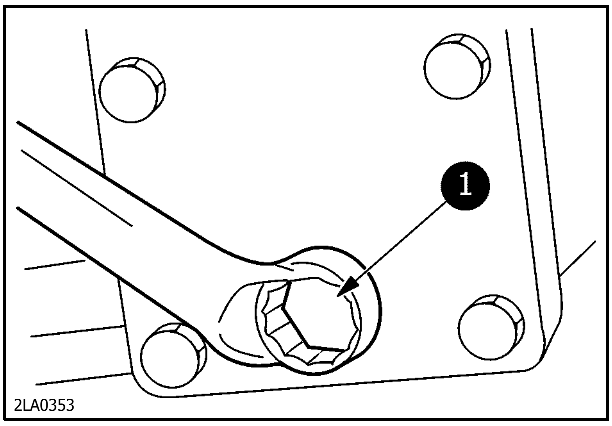
12. Unscrew the plug (1) and drain the oil from the side final drive.

> Old oil must be disposed of in compliance with the current laws in merit.



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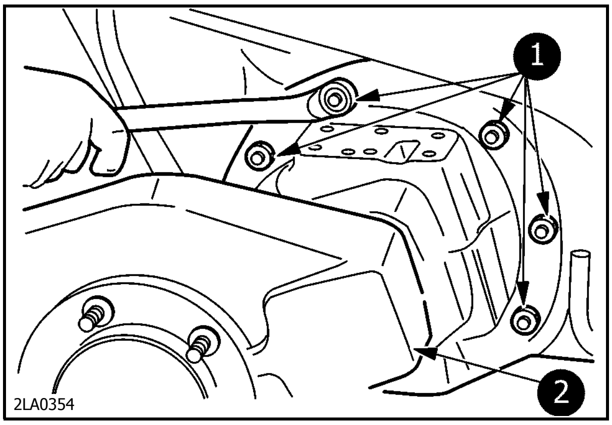
13. Unscrew the fixing nuts (1) and remove the side final drive (2).



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14. Work in a similar way to split the left side final drive, with the exclusion of the operations required to split the power lift valve system.

Remounting

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Remount the right side final drive housing on to the tractor, bearing the following recommendations in mind:

- Before remounting the housings, supports and covers, thoroughly clean and degrease the coupling surfaces and apply a strip of sealant about 2 mm in diameter as indicated in fig. 4.
- Position the side final drive housing on the transmission housing and tighten the fixing screws.
- Mount the platform support.
- Install the rubber support.
- Screw on the platform fixing bolts.
- Connect the support that anchors the anti-side swing chain along with the relative stay.
- Connect the power lift rod.
- Screw on the drain plugs and pour hydraulic oil into the transmission and final drive housing. The prescribed product and relative quantity is given in section 100.
- Mount the rear wheel.
- Remove the chocks from under the wheels.

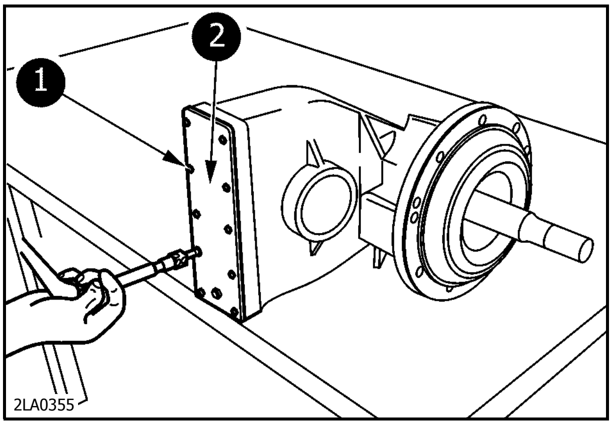
DRIVING WHEEL SHAFT - OVERHAUL

Demounting

WARNING
Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

With the side final drive housing split from the rear transmission, proceed with the demounting operations as described below.

1. Unscrew the fixing screws (1) and remove the closing cover (2).



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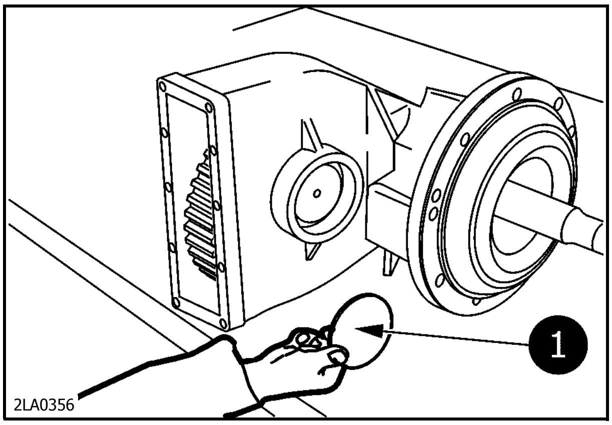
2. Remove the closing seal (4) from the bearing of the driving wheel shaft.



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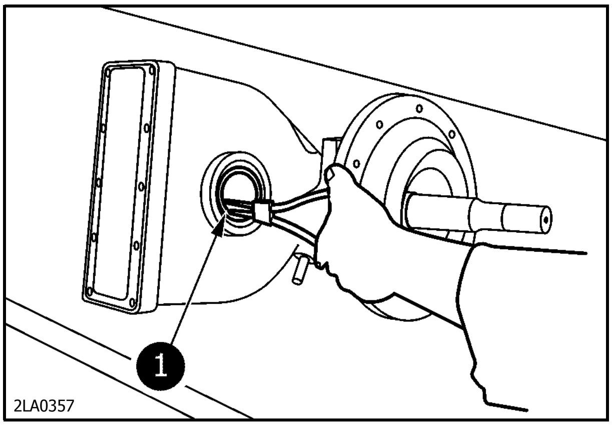
3. Remove the spring ring (1) that holds the driving wheel shaft and recover the float adjuster shim.



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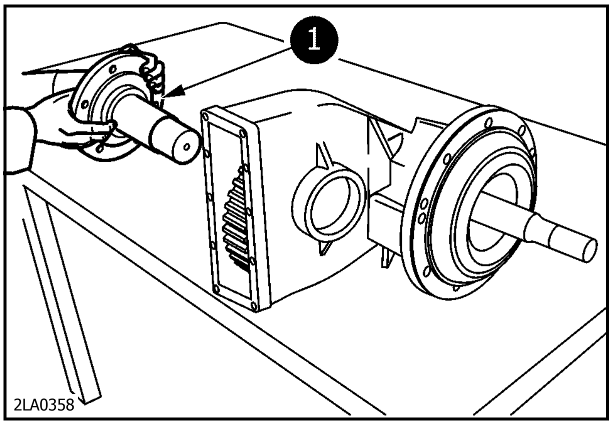
4. Remove the driving wheel shaft (1).



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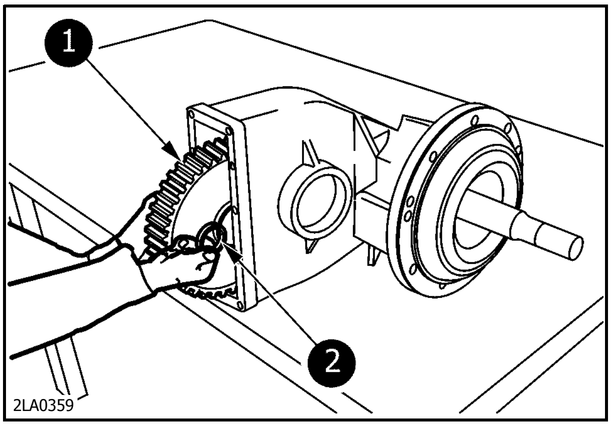
5. Remove the reduction gear (1) and recover the shim (2) that adjusts the float of the gear itself.



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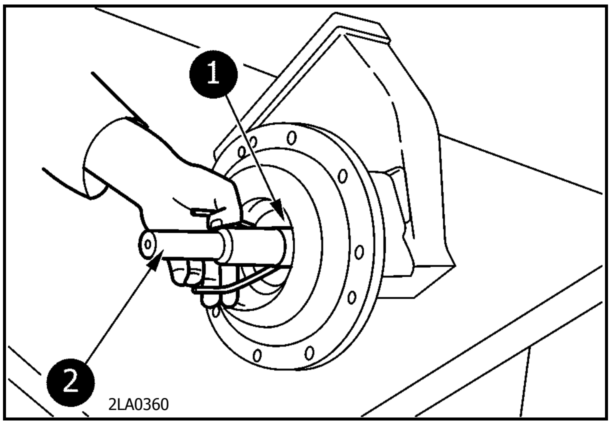
6. Remove the spring ring (1) that holds the bearing of the axle shaft and remove the axle shaft (2) complete with bearing.



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7. Remove the retention seal.

Assembly

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Comply with the following recommendations when remounting the side final drive housing.

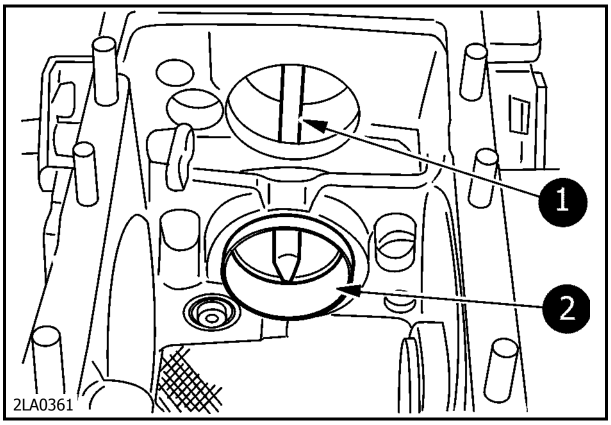
- Consult fig. 2 and 3 in order to position the various parts correctly.
- Before remounting the covers, thoroughly clean and degrease the coupling surfaces and apply a strip of sealant about 2 mm in diameter as indicated in fig. 4.
- Apply the driving torques listed on page 4.
- Mount the axle shaft complete with bearing and relative spring retention rings.
- Position the reduction gear and relative adjuster shim.
- Mount the driving sheel shaft.
- Insert the float adjuster shim and mount the spring ring that holds the driving wheel shaft in place.
- Mount the new retention seal, using an adequate tool.

BEVEL GEAR PAIR ADJUSTMENT

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed in the following way:

1. Take out the track (2) of the pinion bearing using a suitable tool (1).



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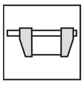
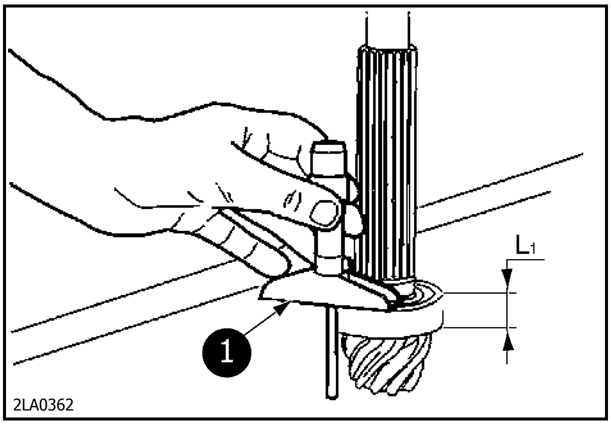


2. Mount the complete bearing on the pinion. Measure dimension (L_1) with a depth micrometer (1).
3. Read the writing on the pinion head and correct the nominal dimension (L_2).



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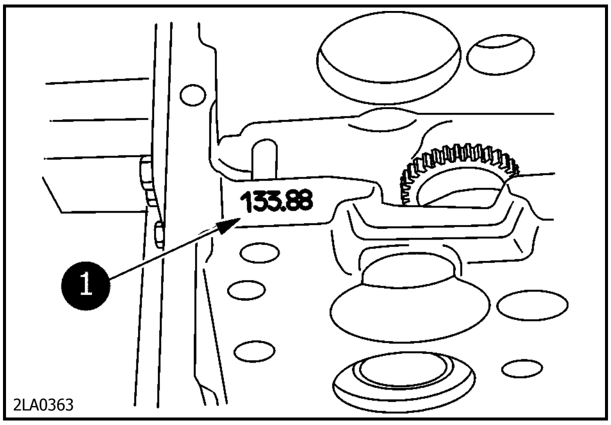
4. Read dimension (L_3) (1), stamped on the top part of the gearbox-transmission housing.



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5. The value of the shims (Sh_1) to mount behind the pinion bearing will be given by:

$$Sh_1 = L_3 - (L_1 + L_2)$$

where:

L_1 = Dimension measured

L_2 = Nominal dimension (correct).

L_3 = Dimension stamped on the transmission housing.

Round off to the lower figure.

Example:

L_1 = 59.25 mm. Dimension stamped

L_2 = 72.2 – 0.3 = 72.2 mm. Nominal dimension (correct).

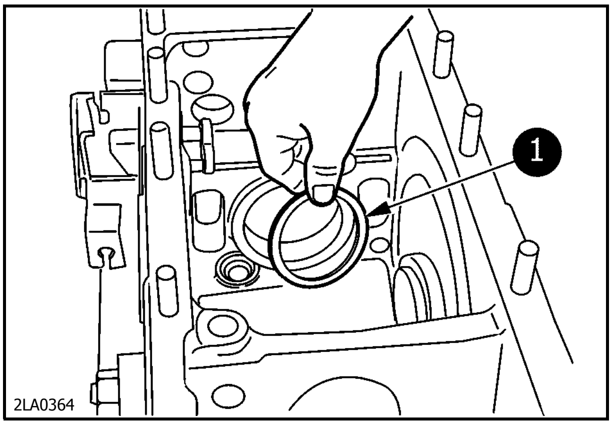
L_3 = 133.88 mm. Dimension measured

Sh_1 = 133.88 - (72.2 + 59.25) = 2.43 mm

(Adjuster shim Sh_1, page 3).

Round off to the lower figure.

6. Insert the calculated shims Sh_1 (1) inside the pinion bearing seat. Mount the bearing and the pinion.



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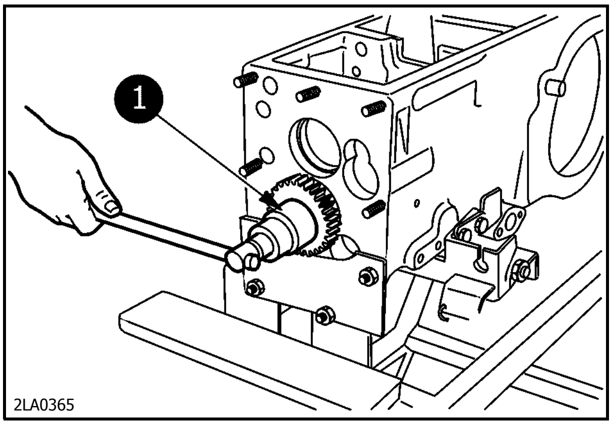
7. To give the right preload to the taper bearing of the pinion, tighten the nut (1) until a 1-6 – 1.8 Nm pinion rolling torque is obtained.



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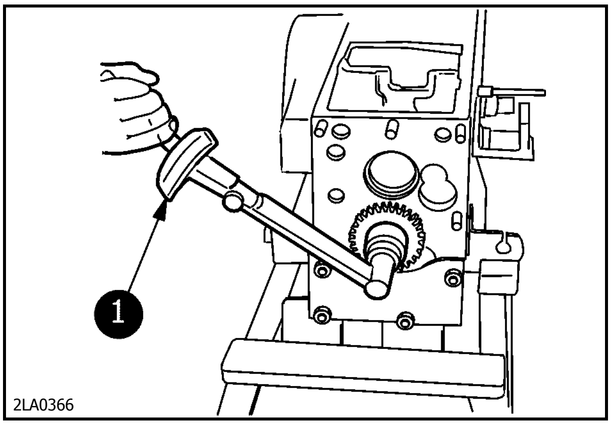
8. Measure the rolling torque with a torque wrench (1).



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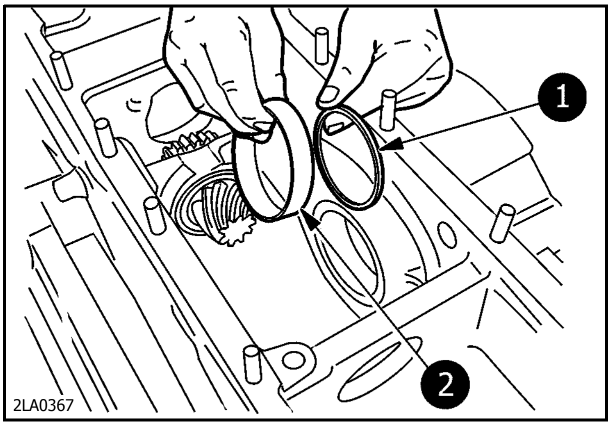
9. Insert a test shim Sh_2 = 2.5 mm (1) behind the track of the bearing of the right support of the ring bevel gear.



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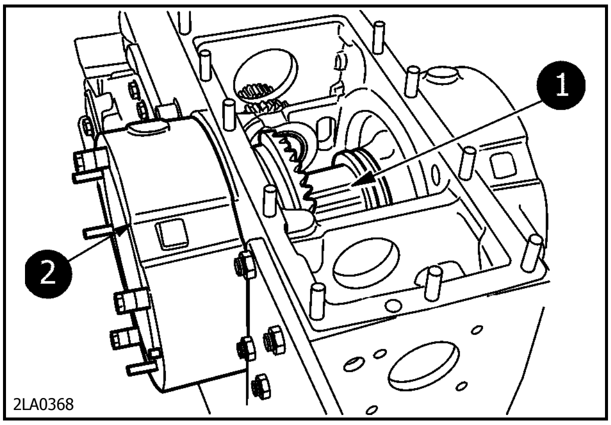
10. Position the ring bevel gear (1) inside the gear-box-transmission housing (2). Mount the left support of the bevel gear pair without any adjuster shims. Tighten the fixing screws of the left support of the bevel gear pair until obtaining a 1.9 – 2.1 Nm rolling torque.



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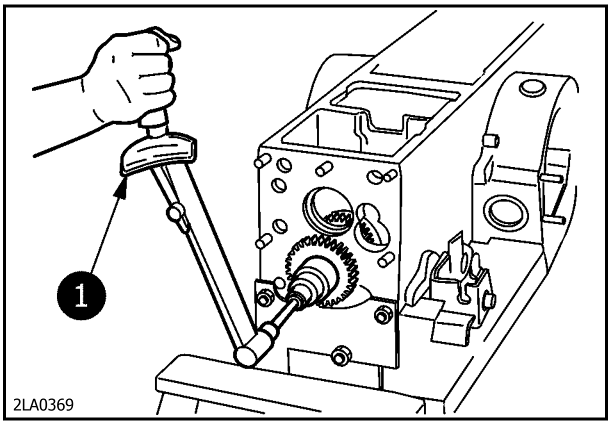
11. The rolling torque can be measured on the pinion locking nut by means of the torque wrench (1).



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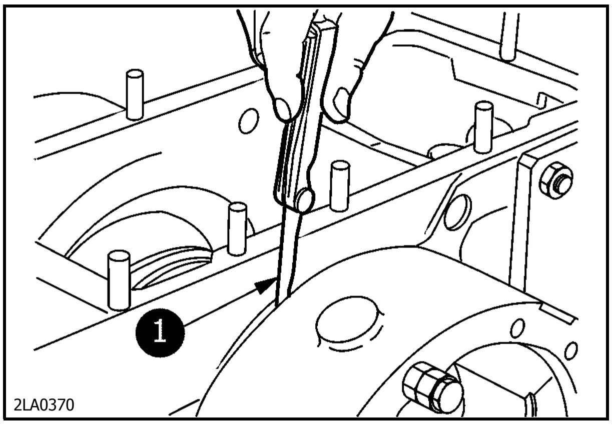
12. Use a thickness gauge (1) to measure the gap (L) between the gearbox-transmission housing and the left support of the ring bevel gear.
Adequately increase the test shim (Sh_2) if gap (L) is L = 0.



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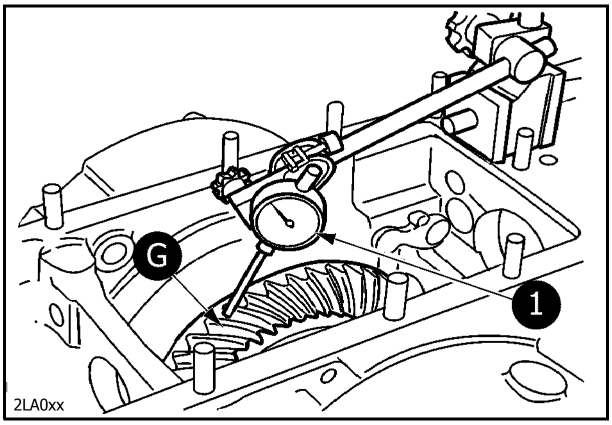
13. The total pack (S_t) of adjuster shims to insert inside the left and right supports of the bevel gear pair is given by:

$$S_t = Sh_2 - L$$

Round off to the lower figure.

14. Use a comparator (1) to measure the play (G) between the flanks of the ring bevel gear teeth.
Take three measurements at 120° and calculate the arithmetical average of the 3 readings.



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15. A correct average play should be between 0.15 mm and 0.22 mm, thus an average 0.18 mm will be considered for the successive calculations.

16. The ring bevel gear float (Z) will be given by:

$$Z = G - 0.18$$

where:

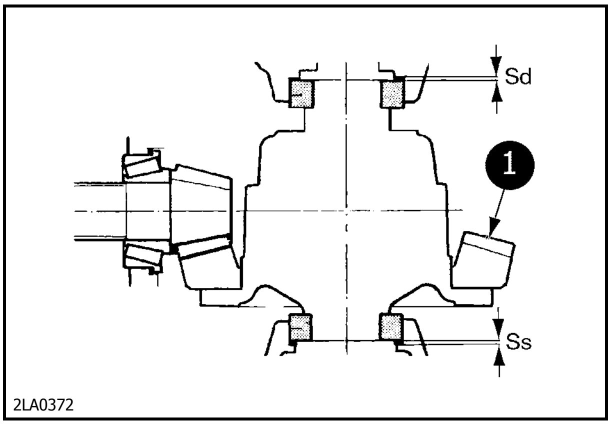
G = Dimension measured.
0.18 = Theoretic dimension.

17. The left (S_s) and right (S_d) adjuster shims to insert behind the taper bearing of the left and right ring bevel gear supports will be given by:

$$\mathbf{S_d = S_t - Z}$$

$$\mathbf{S_s = S_t - S_d}$$

Round off to the lower figure within 0.5 mm.



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18. Mount the ring gear supports with the calculated adjuster shims and, as previously described, check the ring gear-pinion rolling torque and the play between the flanks of the ring bevel gear teeth.

Example

S_t = 2.5 mm.
Theoretic dimension of the test shim.

L = 0.2 mm.
Dimension measured.

S_t = 2.5 – 0.2 = 2.3 mm.
Total adjuster shim.
Round off to the lower figure.

G = 0.38 mm.
Dimension measured.
0.18 mm
= Theoretic dimension.

Z = 0.38 – 0.18 = 0.2 mm.
Ring gear float.

S_d = 2.3 – 0.2 = 2.1 mm.
Adjuster shim on the right ring bevel gear support.

S_s = 2.3 – 2.1 = 0.2 mm.
Adjuster shim on the left ring bevel gear support.

Round off to the lower figure within 0.5 mm.

SECTION 510

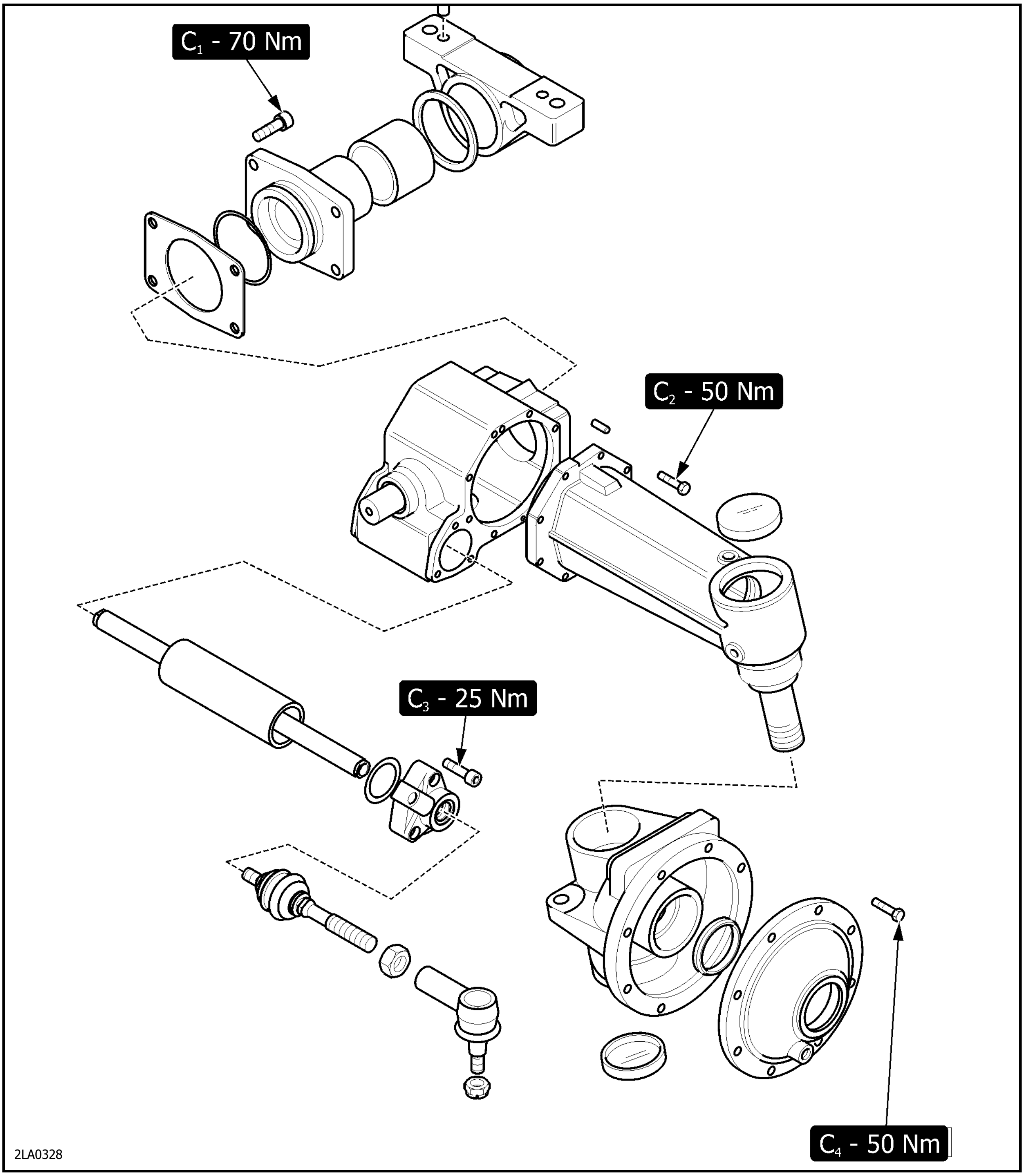
FRONT AXLE

INDEX

MAIN SPECIFICATIONS

Type	In spheroidal cast iron, pivoting at the center within two supports
Front drive engaging control	Mechanical, by means of a lever
Drive transmission	By central differential and bevel gear pair reduction units
Differential locks	
- type	"Twin lock" with electrohydraulic control
- engaging phase	at the same time as the rear differential
- disengagement	by means of the brake pedals
Central bevel gear pair	19/41
Upper bevel gear pair	21/22
Lower bevel gear pair	11/45
Maximum steering angle	55°
Maximum swing angle	12°

DRIVING TORQUE VALUES



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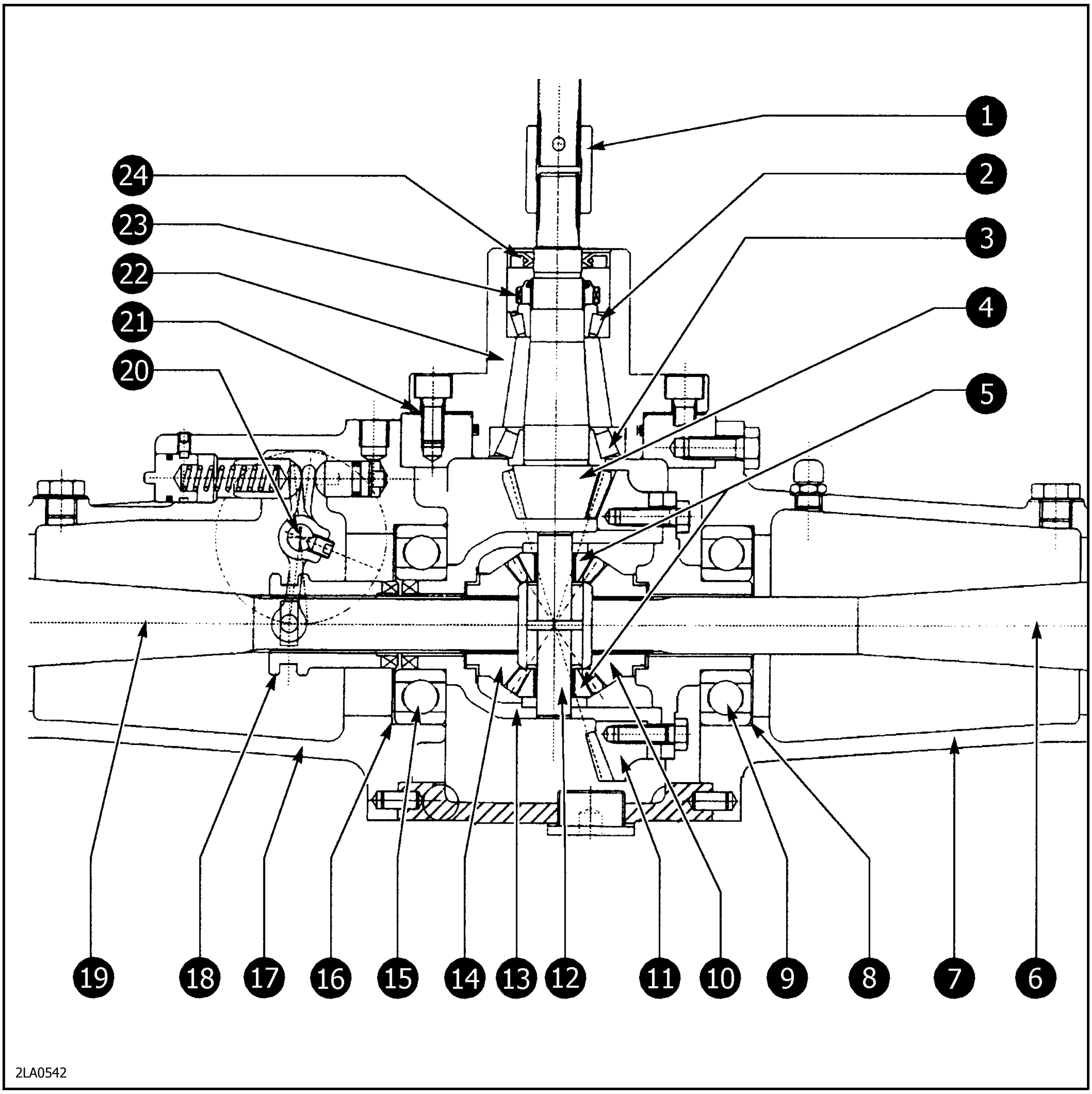
PARTS TO TORQUE	Driving torque values	
	Nm	kgm
Screw fixing pinion support to the central housing (C1)	70	7.15
Screw fixing side final drive housing to the central housing (C2)	50	5.10
Steering cylinder cover fixing screw (C3)	25	2.55
Screw fixing hub to kingpin (C4)	50	5.10

SPECIFIC EQUIPMENT

Code	Description
001 DT MIS	Lock nut wrench
002 DT MIS	Pinion play adjuster tool
003 DT MIS	Lock nut wrench
004 DT MIS	Kingpin play adjuster tool

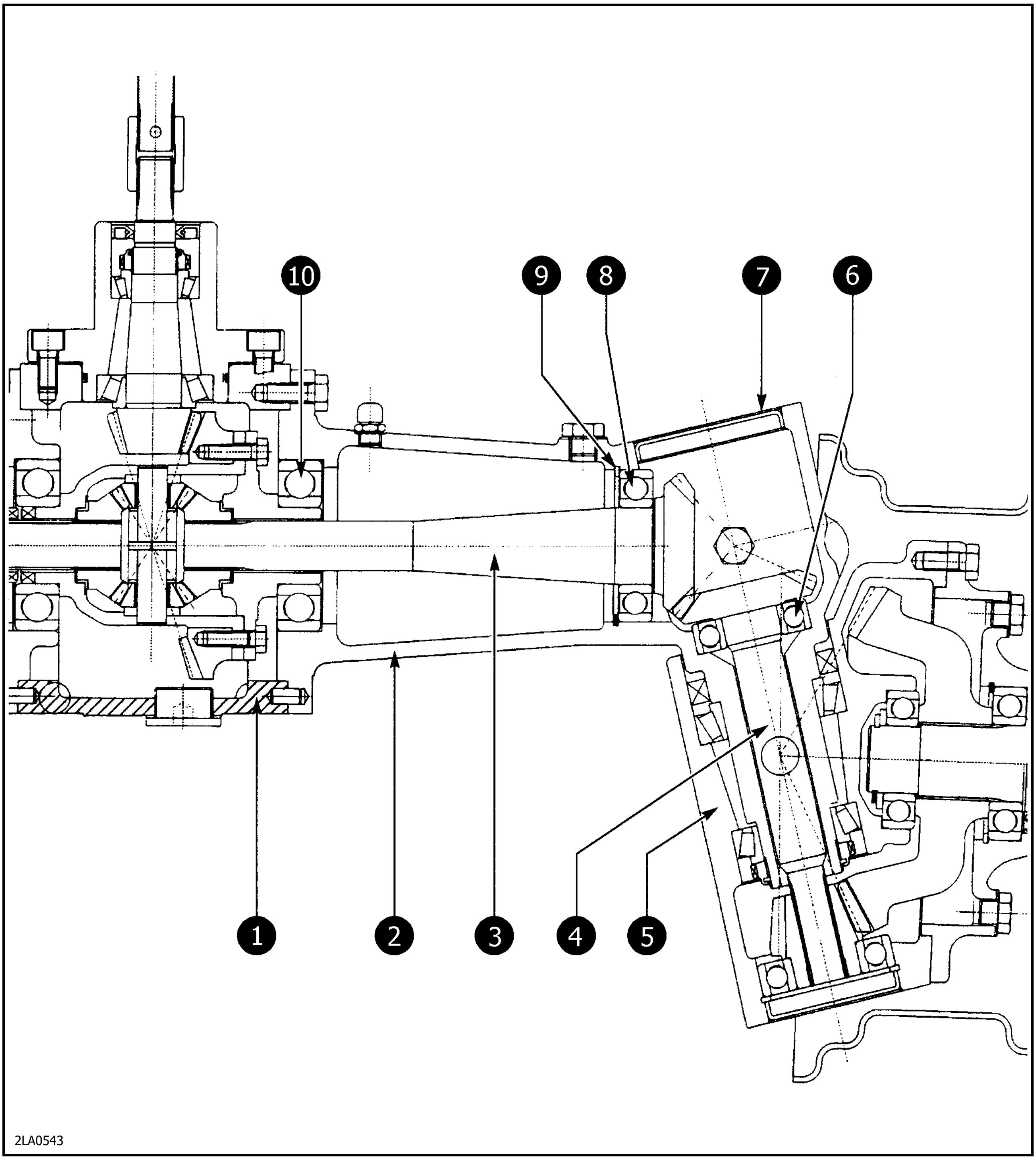
SECTIONS



2

Central differential section

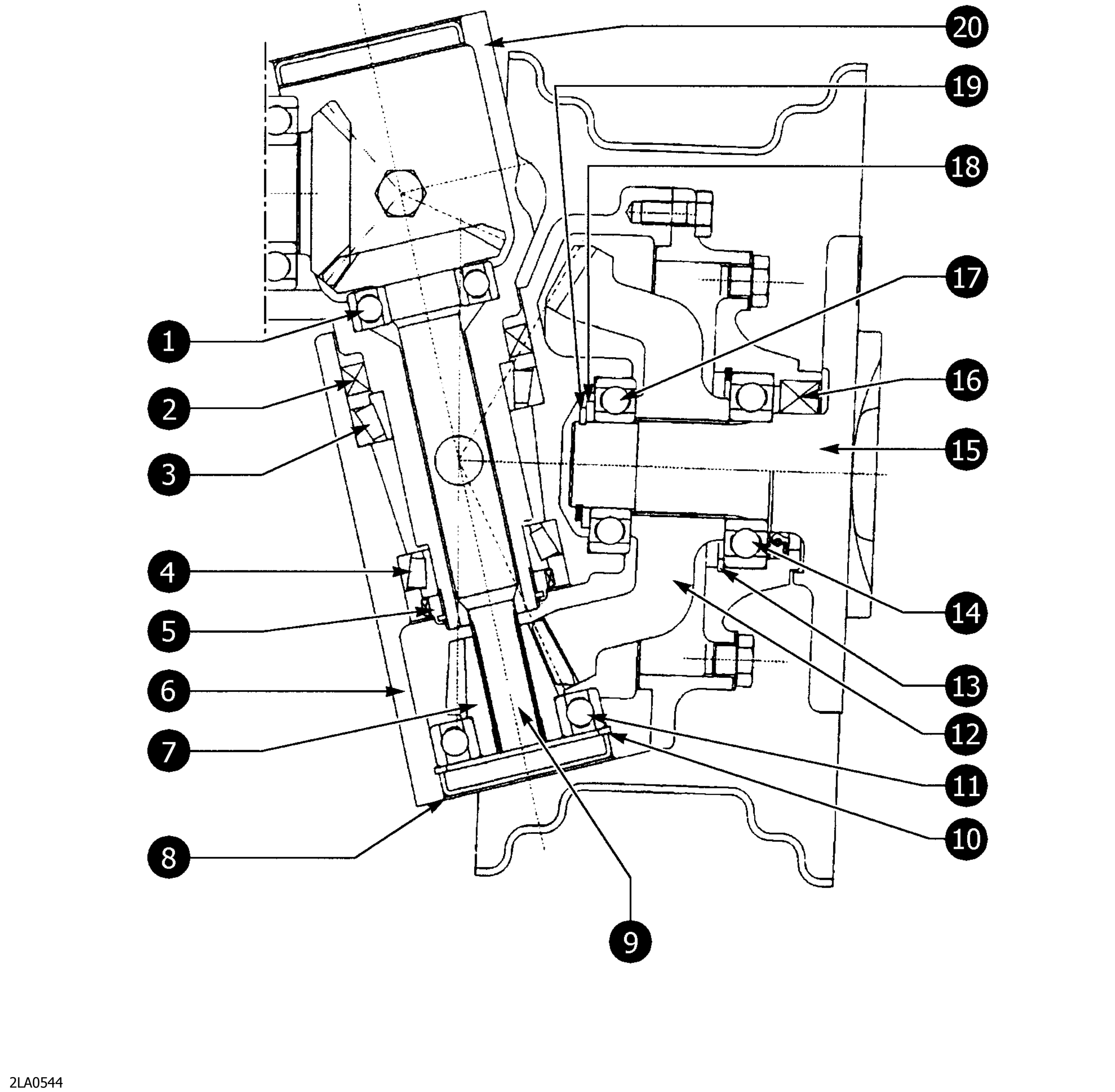
1. Transmission shaft coupling
2. Outer pinion taper roller bearing
3. Inner pinion taper roller bearing
4. Bevel pinion.
5. Planetary
6. RH axle shaft.
7. Side final drive housing
8. Central bevel gear pair adjuster shims
9. RH differential bearing
10. Crown wheel
11. Bevel ring gear
12. Planetary pin
13. Differential housing
14. Crown wheel
15. LH differential bearing
16. Central bevel gear pair adjuster shims
17. Side final drive housing
18. Diff lock sleeve
19. RH axle shaft.
20. Diff lock
21. Central bevel pinion adjuster shims
22. Pinion support
23. Central bevel pinion bearing adjuster nut
24. Seal



3

Split axle shaft section

1. Bevel gear pair housing
2. Side final drive housing
3. Horizontal axle shaft.
4. Vertical axle shaft
5. Pivot pin
6. Vertical axle shaft support bearing
7. Cover
8. Horizontal axle shaft support bearing
9. Spring ring.
10. Differential bearing



4

Section drawing of final drives and hubs

1. Vertical axle shaft support bearing
2. Seal
3. Upper pivot taper roller bearing
4. Lower pivot taper roller bearing
5. Taper roller bearing lock nut
6. Pivot pin
7. Final drive bevel pinion
8. Cover
9. Vertical axle shaft
10. Spring ring.
11. Pinion support bearing
12. Final drive ring bevel gear
13. Spring ring.
14. Outer bearing to support bevel gear
15. Hub
16. Seal
17. Inner bearing to support bevel gear
18. Spacer
19. Spring ring.
20. Side final drive housing

DESCRIPTION AND OPERATION

Axle assembly

The front axle consists of a lockable central differential, split rigid axle shafts, integral pivot pins and final drives with bevel gear pairs in the hubs.

The differential assembly has four planetary gears and can be locked by means of a hydraulically controlled clutch mechanism with frontal teeth.

Torque is transmitted from the differential to the final drives through the axle shafts, each of which split by means of a pair of bevel gears, and coaxially passes through the relative pivot pin.

The steering housing is installed in front of the axle and, by means of linkages, turns the hubs around the pivot pins.

The axle can swing around the horizontal axle as it is borne by two supports fixed to the chassis.

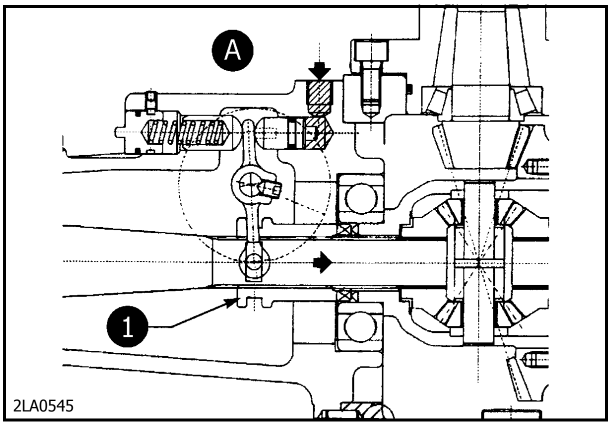
Differential lock

In the locked position (A), the sleeve (1, fig. 5) with frontal toothing meshes with the relative toothing on the differential housing.

Since the sleeve is grooved on the inside and thus enbloc with the axle shaft, the differential housing and the lh axle shaft (and, consequently, the other axle shaft) are enbloc with each other in this position.

Both axle shafts therefore spin at the same speed and the differential is locked.

Engagement is obtained by allowing fluid under pressure to flow to a hydraulic piston that acts on the engaging fork.



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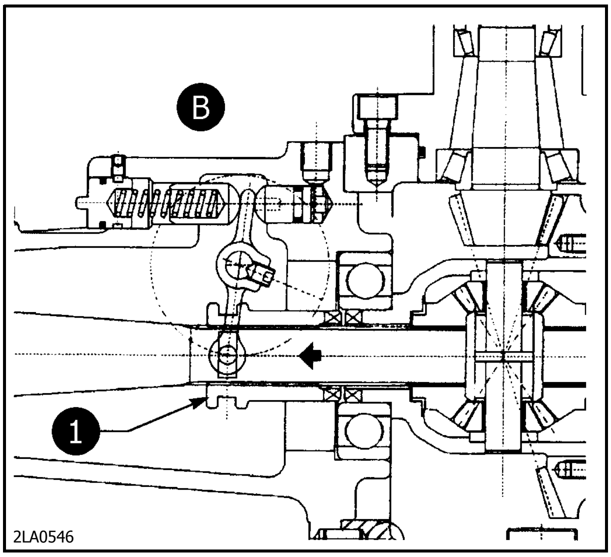
In the unlocked position (B), the sleeve (1, fig. 6) is moved away from the toothing, thus releasing the differential housing which continues to operate normally.

Disengagement is obtained by relieving the pressure of the fluid that acts on the piston, while a return spring moves the piston to the unlocked position and keeps it there.



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TROUBLESHOOTING FOR THE FRONT AXLE DIFF LOCK DEVICE

Faults	Possible causes	Remedies
The diff lock fails to engage	**1.** The diff lock control switch is inefficient	Replace the switch
	2. No power transmitted to the solenoid valve: connections disconnected, damaged or relay defective	Make the electrical connection and replace the defective parts
	3. Controlling solenoid valve jammed in the discharge phase	Overhaul or replace the solenoid valve
	4. Oil leaks through the seals, with consequent drop in pressure	Replace the defective seals
	5. Inefficient hydraulic circuit	Overhaul the circuit
The diff lock fails to disengage	**1.** Controlling solenoid valve jammed in the delivery phase	Overhaul or replace the solenoid valve
	2. No power transmitted to the solenoid valve: connections disconnected, damaged or relay defective	Make the electrical connection and replace the defective parts
	3. Faulty release spring	Replace the spring

FRONT AXLE

Splitting

DANGER

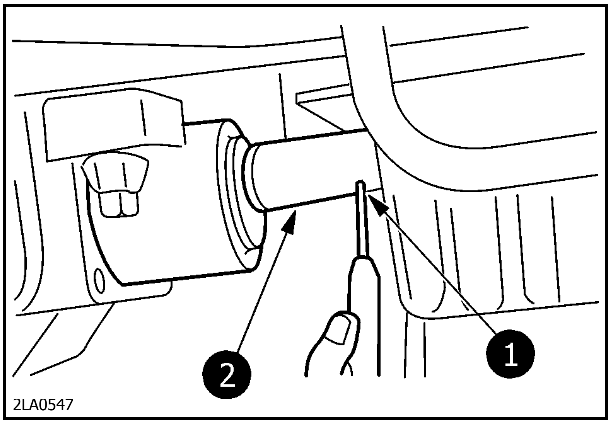
Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units or parts are supported by appropriately sized harness and hooks.
Make sure that there are no bystanders near the load being lifted.

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

1. Place chocks under the rear wheels.
2. Remove the spring pin (1) that fixes the PTO shaft sleeve (2).



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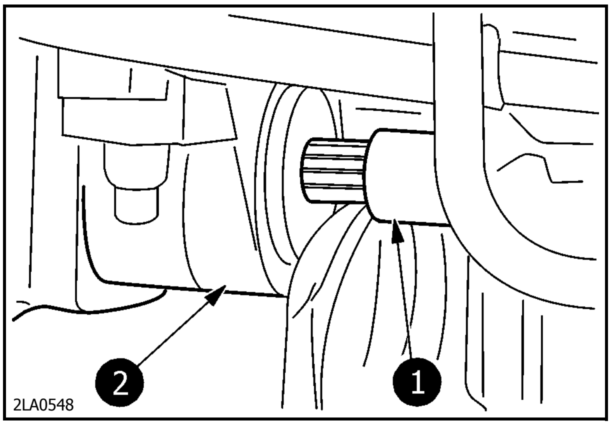
3. Move the PTO shaft sleeve (1) backwards and disconnect it from the front axle (2).



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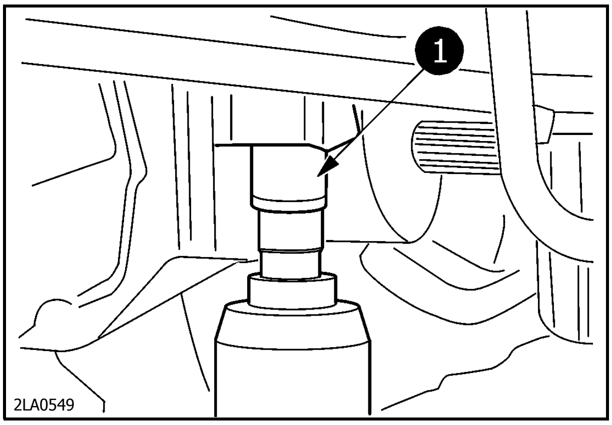
4. Unscrew the fixing screws (1) of the front axle.



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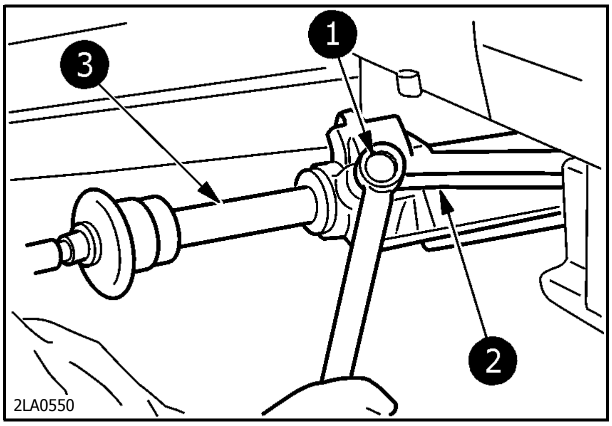
5. Unscrew the screws (1) that fix the hose (2) from the power steering cylinder (3) and drain the fluid from the power steering system.

Old oil must be disposed of in compliance with the current laws in merit.



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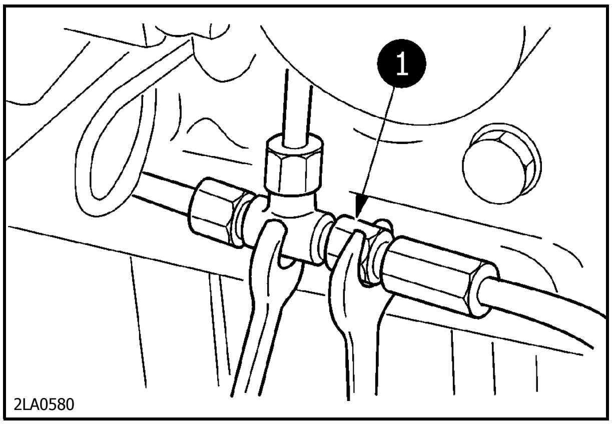
6. Disconnect the hose (1) from the T union.



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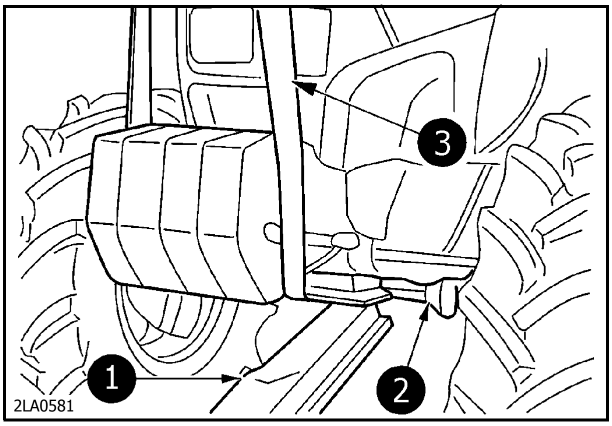
7. Place a lift (1) under the front axle (2). Pass a harness (3) under the front ballast and lift the tractor until it splits from the front axle.



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Remounting

> **WARNING**
>
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Comply with the following instructions when fitting the complete axle assembly back on to the tractor:

- Position the complete axle assembly under the tractor. Lower this latter until it touches the axle, then recover the lifting rope.
- Fit the complete axle assembly back on the tractor and torque the fixing bolts.
- Connect the hose to the power steering cylinder and T union. Torque the bolts.
- Connect the PTO sleeve to the front axle.
- Fit the spring pin that fixes the PTO shaft sleeve to the front axle.
- Screw on the drain plugs and pour oil into the power steering system. The prescribed product and relative quantity is given in section 100.
- Remove the chocks from under the wheels.

FRONT AXLE DIFFERENTIAL AND BEVEL GEAR PAIR SUPPORT

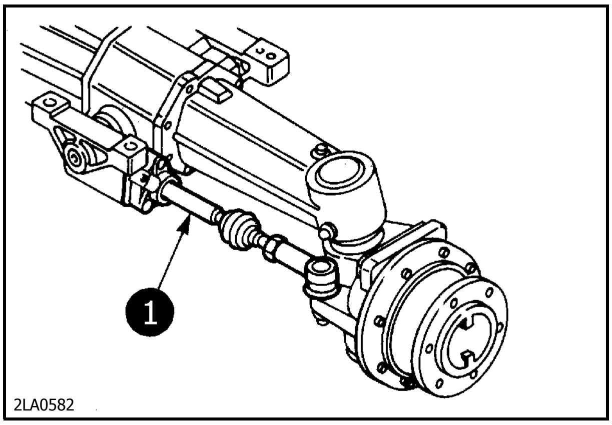
Splitting

DANGER
Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units or parts are supported by appropriately sized harness and hooks.
Make sure that there are no bystanders near the load being lifted.

WARNING
Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

1. Remove the axle steering cylinder (1).



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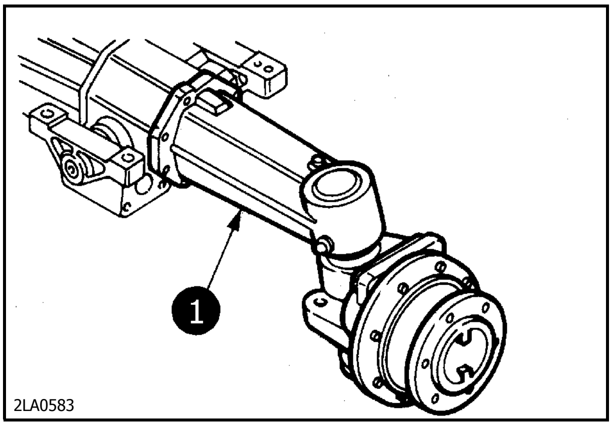
2. Remove both side housings (1).



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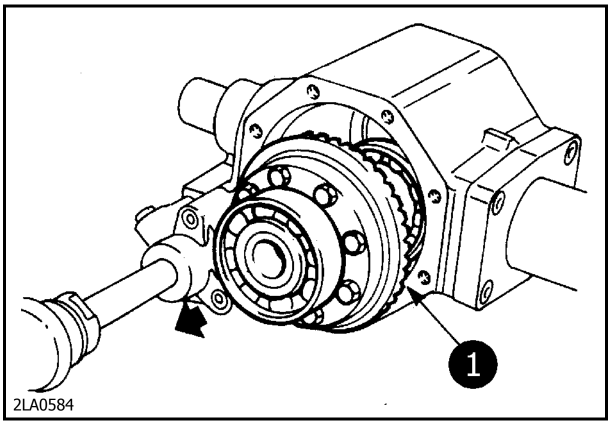
3. Remove the differential assembly (1) from the central housing.



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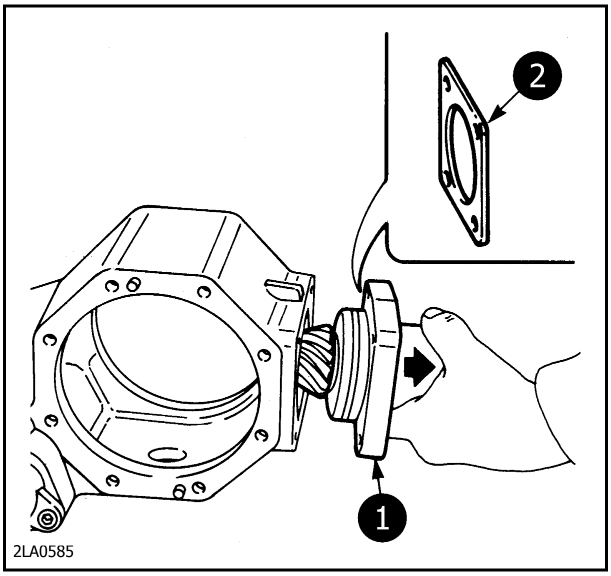
4. Unscrew the screws that fix the bevel pinion support and remove the actual support itself (1). Recover the spacer (2).



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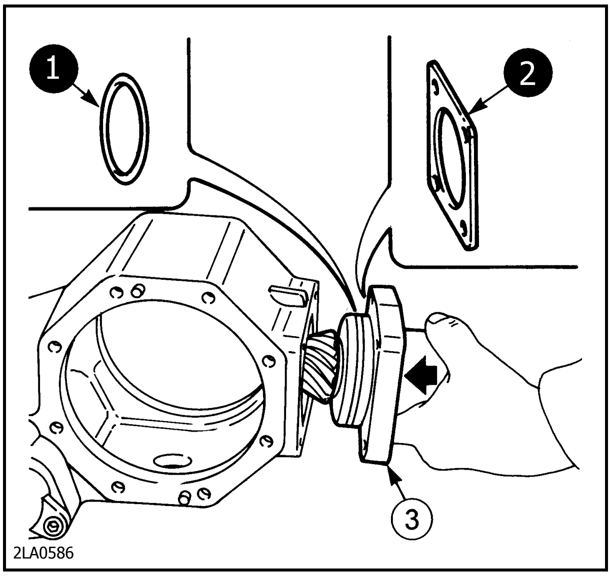
Remounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Remount the front bevel gear pair support bearing the following recommendations in mind:

- Refer to figs. 2, 3 and 4.
- Apply the driving torques listed on page 4.
- Mount a new retention ring (1). Mount the adjuster spacer (2) and then mount the bevel pinion support (3).
- Proceed by remounting both side housings.
- Now remount the axle steering cylinder.



17

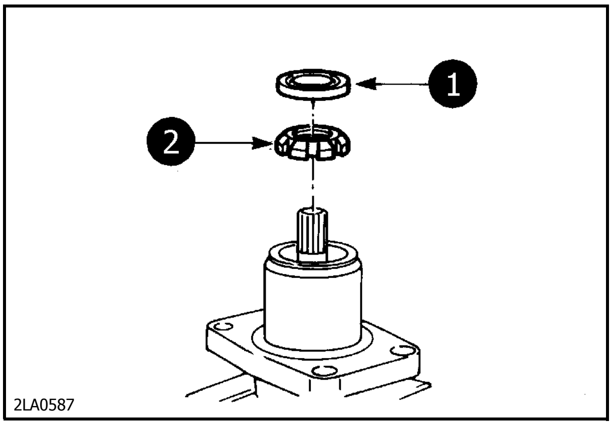
FRONT BEVEL GEAR PAIR - OVERHAUL

Demounting

WARNING
Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

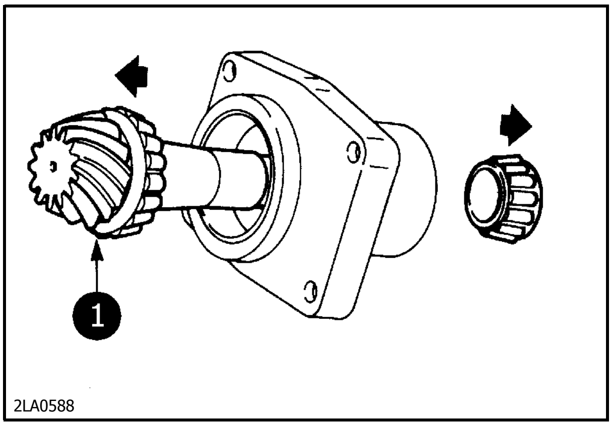
Proceed as follows:

1. Remove the seals (1). Unscrew the locking rings nut (2) with wrench **001 DT MIS** and remove it.



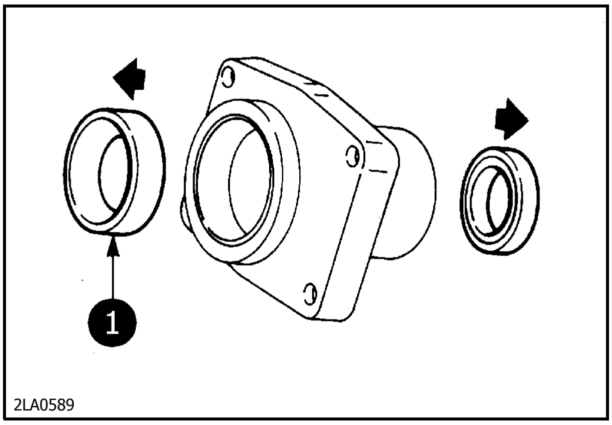
18

2. Remove the pinion (1) complete with inner bearing rings.



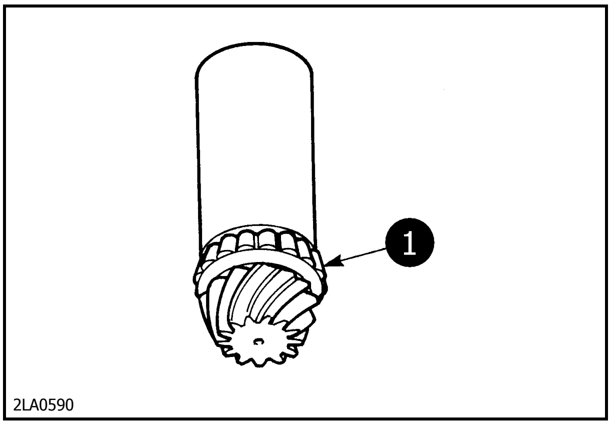
19

3. Remove both the outer rings (1) from the support. Remove the inner ring from the pinion if necessary.



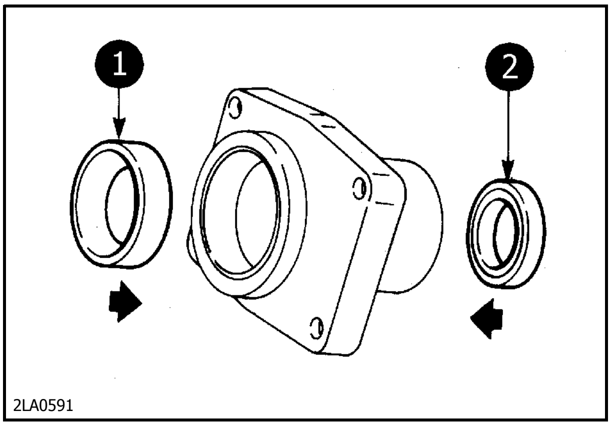
20

4. Remount the front bevel gear pair bearing the following recommendations in mind:
   - Refer to figure 2.
   - Apply the driving torques listed on page 4.
   - Proceed by remounting the parts in the following way:
5. If removed, mount the inner bearing ring on the pinion side on the actual pinion itself, using an adequate plug.



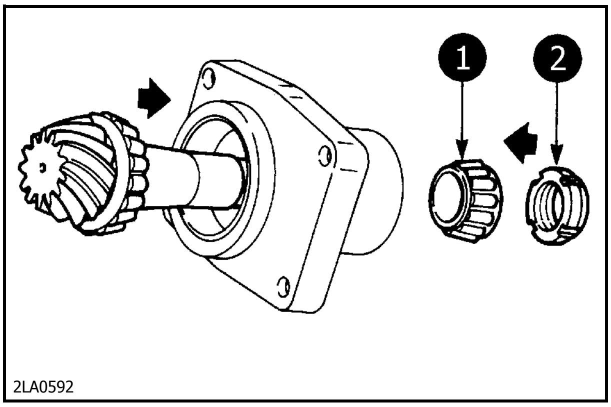
21

6. Mount the outer ring on the pinion side (1) and grooved side (2), into the relative seats in the support.



22

7. Mount the pinion into the support. Now mount the inner bearing on the grooved side (1) and then mount the lock nut (2).



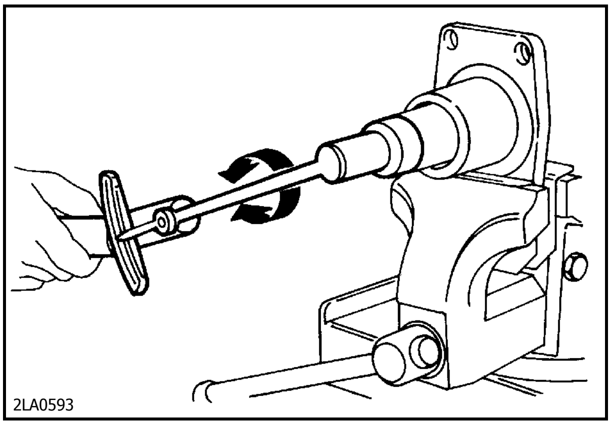
23

Bevel pinion bearing preload

Proceed as follows:

1. Tighten the lock until until the prescribed pinion bearing preload is obtained.

Pinion bearing rolling torque:
1.0 - 1.2 Nm



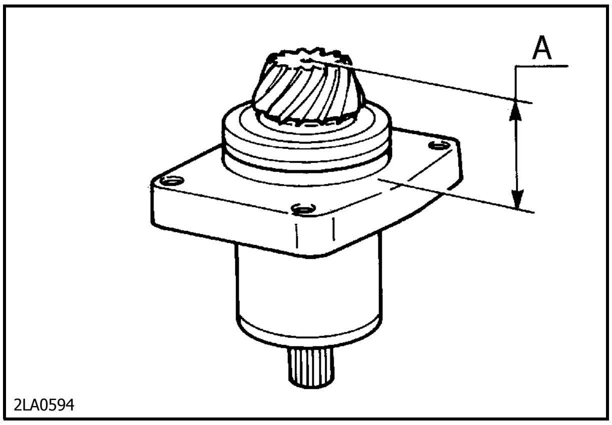
24

Adjustment of the axial position of the bevel pinion

Proceed as follows:

1. Measure the distance between the pinion head and bearing flange (dimension A).
2. Measure the thickness of the central housing wall (dimension C).
3. Measure the inner diameter of the seat of the side final drive housing (dimension D).
4. Establish the effective distance (dimension B) between the pinion head and ring gear axis by applying the following relation.

B = (D/2) + C - A mm



25

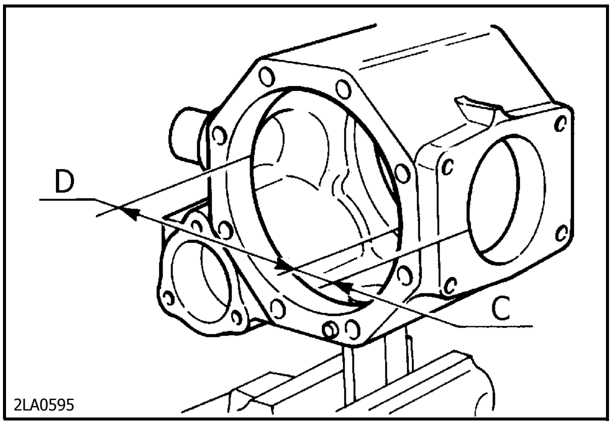
5. Establish the thickness of the spacer to apply between the pinion support and central housing by applying the following relation.

S = 48 mm - B

Example:
D = 142 mm
C = 24 mm
A = 48.5 mm

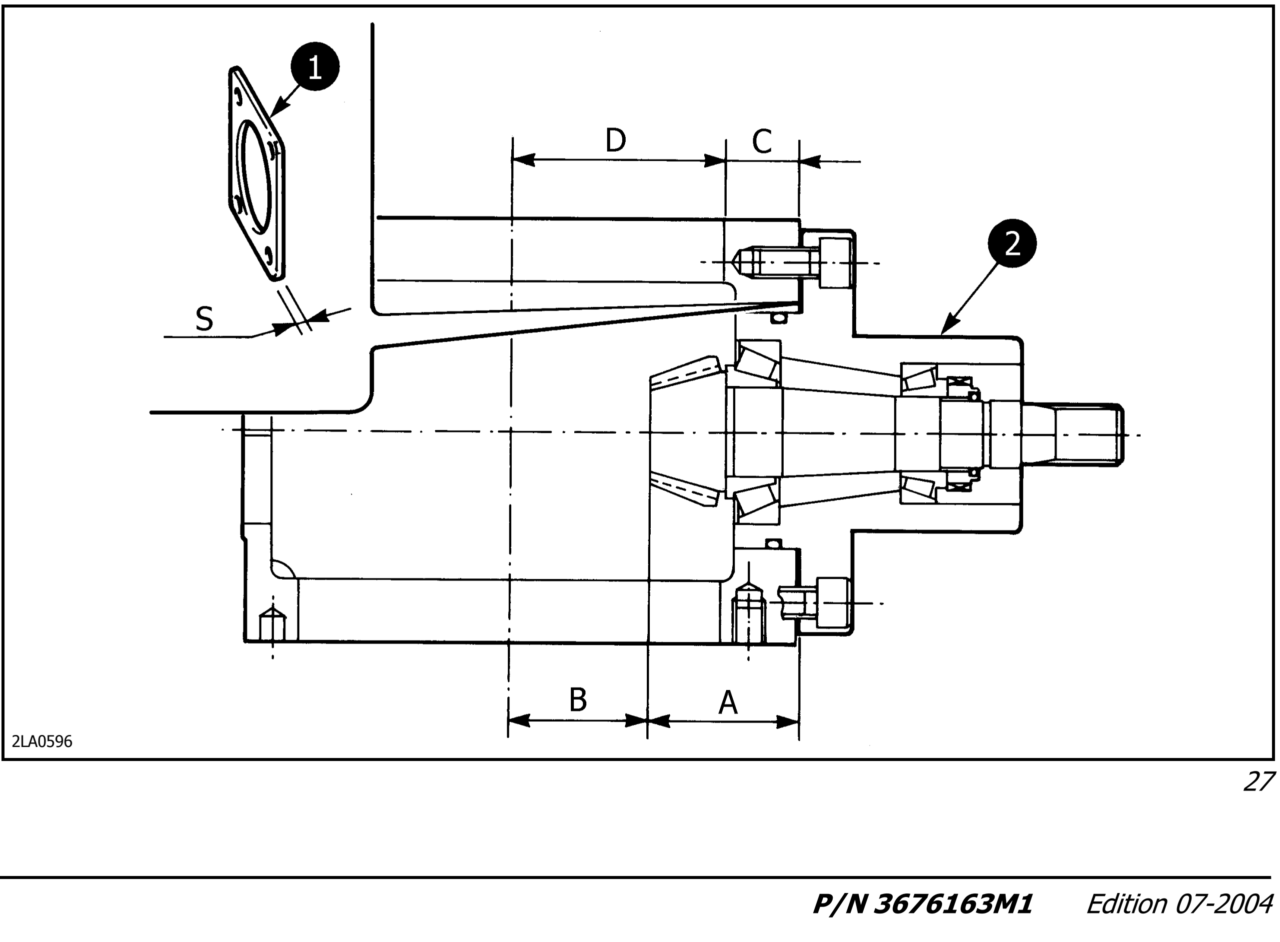
obtains B = (142 : 2) + 24 – 48.5 = 46.5 mm

thus S = 48 – 46.5 = 1.5 mm



26

6. Mount calculated spacer S (1) and the pinion support (2) then tighten the screws to the prescribed torque value.

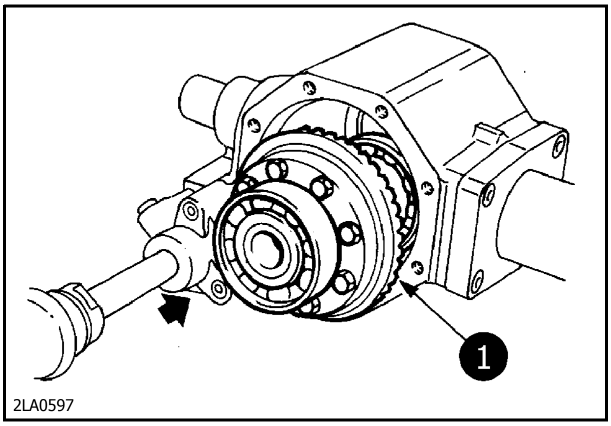


27

Pinion – ring gear play adjustment

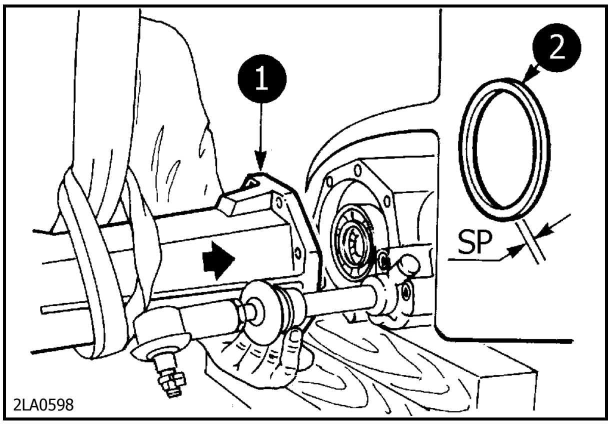
Proceed as follows:

1. Fit the differential assembly (1) into the central housing.



28

2. Mount both the side housings (1), inserting a SP = 3 mm spacer (2) and fitting four screws in a diagonal position without torquing them.



29

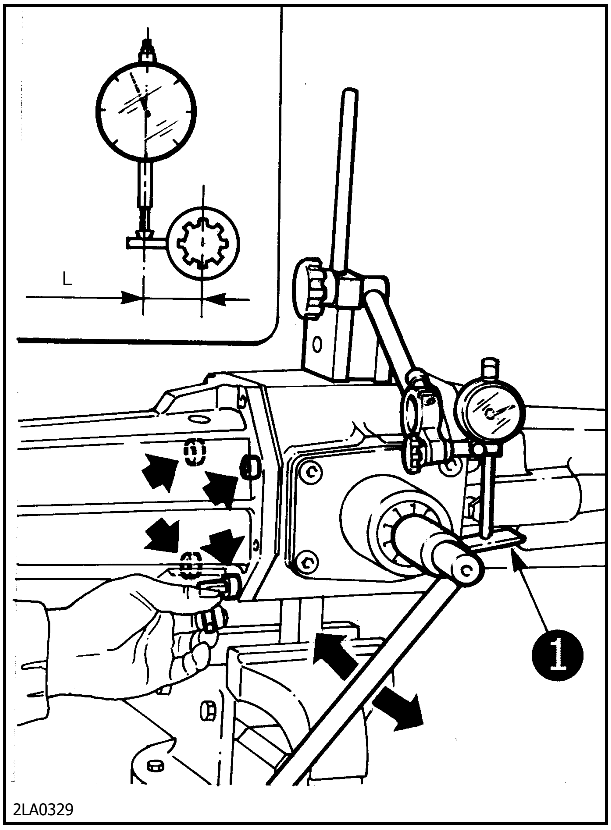
3. Mount tool **002 DT MIS** (1) on the grooved pinion tang, then mount a centesimal comparator in the indicated direction, in order to measure the play.

> The measurement must be made about 25 mm from the pinion axis (distance (L)).

4. Tighten the screws of the side housing on the ring gear side (shown by the arrows in the figure) in a uniform way while measuring the pinion – ring gear play until the prescribed value has been obtained.

Pinion – ring gear play 0.8 - 0.22 mm

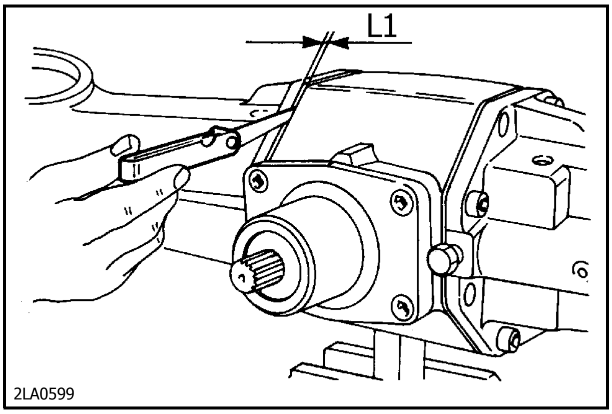
> It is advisable to use a thickness gauge to maintain an even gap between the two housings.



30

5. Use a thickness gauge to measure residue gap L_1.
6. Establish the value of shim S_1 by applying the following relation:

$$S1 = SH - L1$$



31

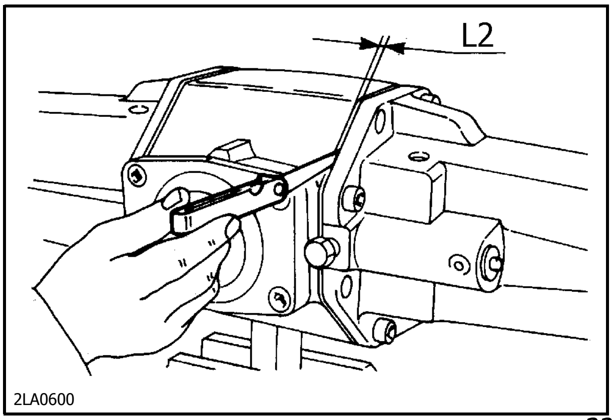
Ring gear bearing float adjustment

Proceed as follows:

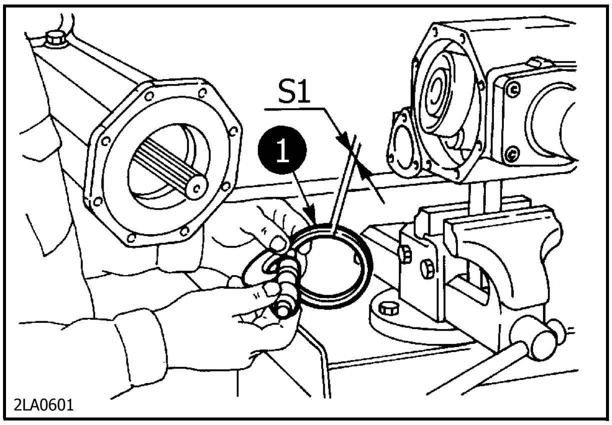
1. Remove the complete pinion support to access the differential.
2. Proceeding in a similar way, tighten the screws of the side housing on the opposite side in an uniform way in order to annul the float of the differential bearings.
3. Use a thickness gauge to measure residue gap L_2.
4. Establish the valve of shim S_2 by applying the following relation:

$$S_2 = SH - L_2$$

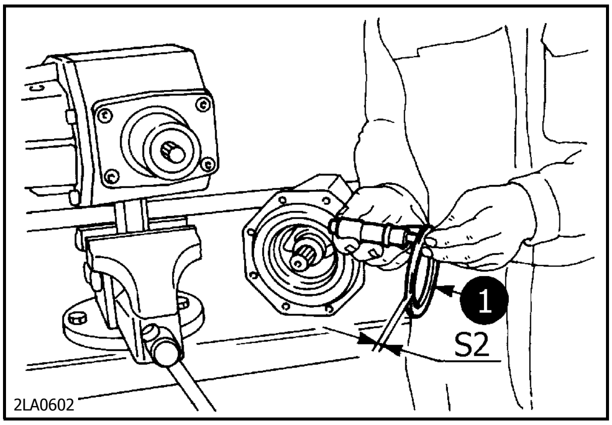
5. Remove the side housings and insert previously calculated spacers with thickness S_1 for the one on the ring gear side and S_2 for the one on the side opposite the ring gear.



32



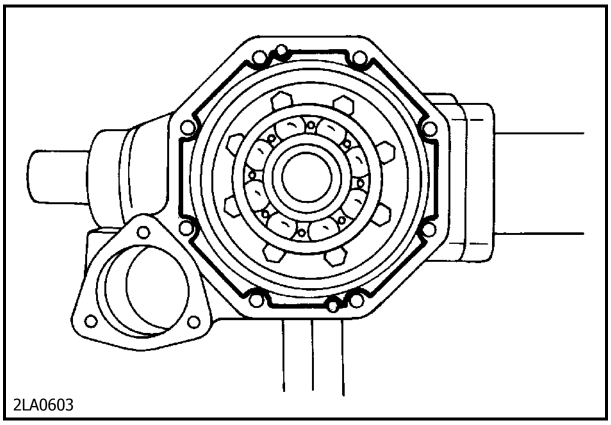
33



34

6. Apply sealant along the indicated part of the jointing edge between the side housing and central housing.

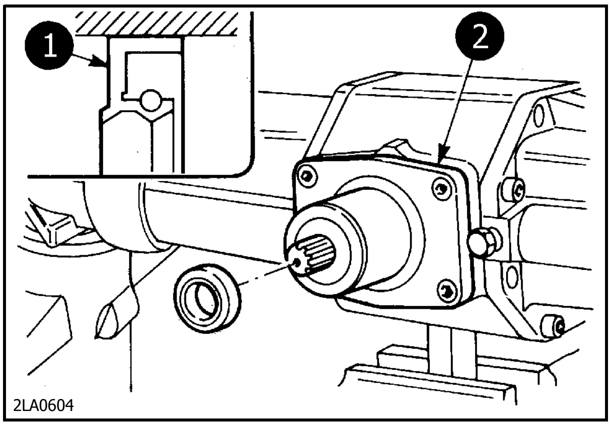
7. Remount both side housings and tighten the screws to the prescribed driving torque value.



35

8. Remount the pinion support with the spacer and retention ring, then tighten the screws to the prescribed driving torque value.

9. Mount the seal (1) on the pinion support (2) using a suitable mallet and complying with the indicated positions.



36

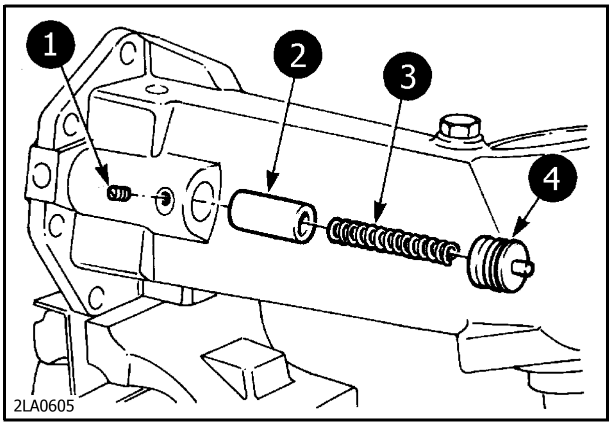
FRONT DIFF LOCK - OVERHAUL

Demounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

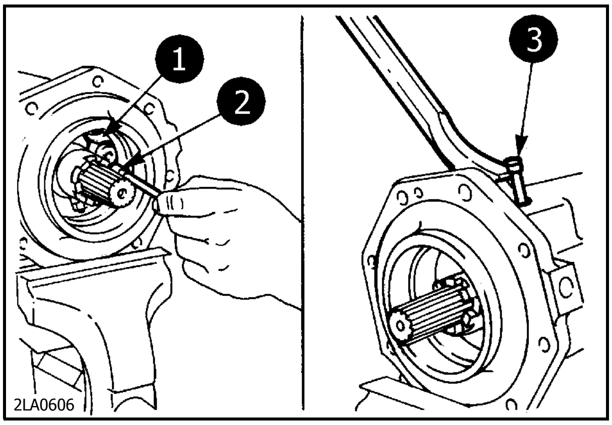
Proceed as follows:

1. Remove the left side housing.
2. Unscrew the locking screw (1) and remove the plug (4), the spring (3) and the counter-rod (2).



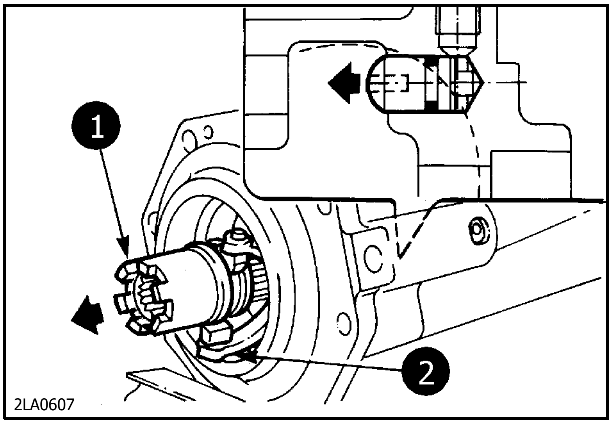
37

3. Unscrew the retainer screw (2). Tighten an M6 screw (3) on to the fork pin (1) and use it as a puller to remove this latter as indicated.



38

4. Remove the fork (2) and sliding sleeve (1). Also remove the control plunger from the housing.



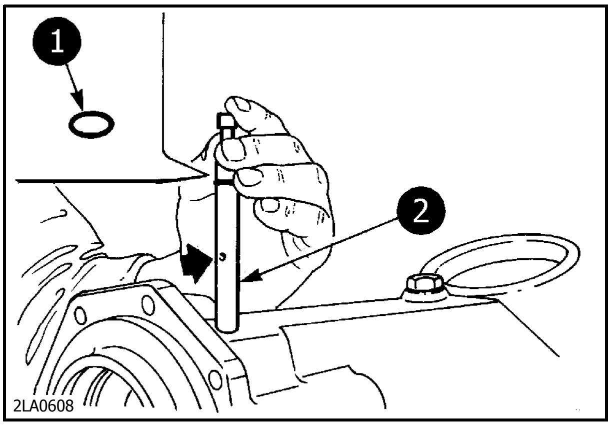
39

Assembly

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Remount the front differential lock bearing the following recommendations in mind:

- Refer to fig. 2.
- Apply the driving torques listed on page 4.
- Mount a new retention ring and fit the plunger back into its housing.
- Mount the sliding sleeve along with the fork inside the side housing.
- Mount a new retention ring and fit the pin into the fork, complying with the position of the threaded hole as indicated.
- Tighten the fork retainer screw.
- Mount the rod, the spring and the plug and lock in place with the screw.
- Check by hand to make sure that the device operates correctly.
- Proceed by remounting the left side housing.

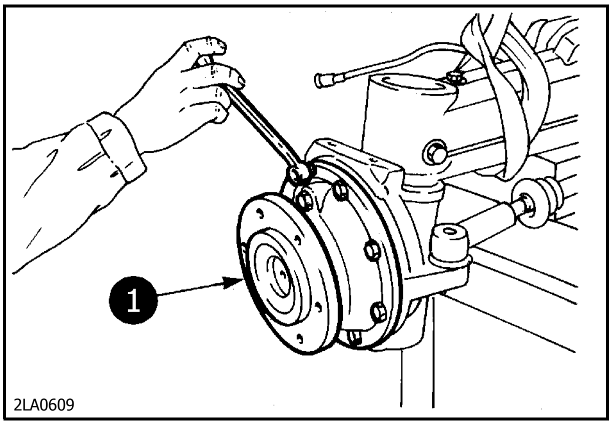


40

WHEEL HUB - OVERHAUL

Demounting

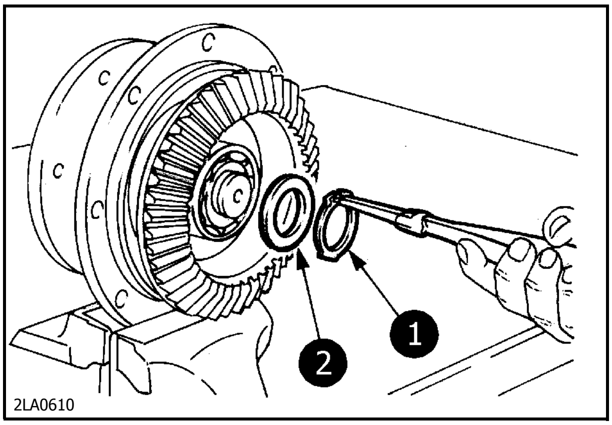
> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.



41

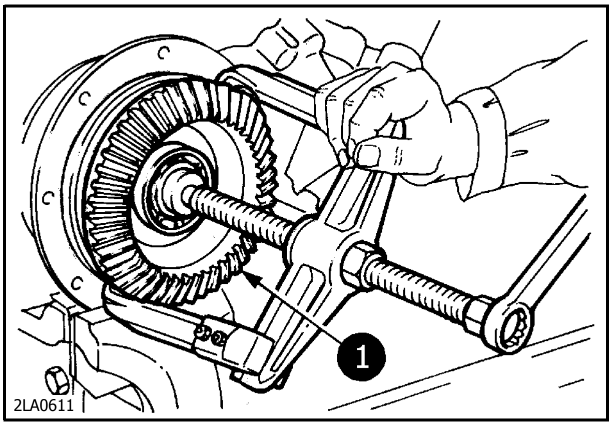
Proceed as follows:

1. Unscrew the hub fixing screws (1, fig. 41) and remove the hub complete with bevel gear.
2. Remove the spring ring (1) and the spacer (2).



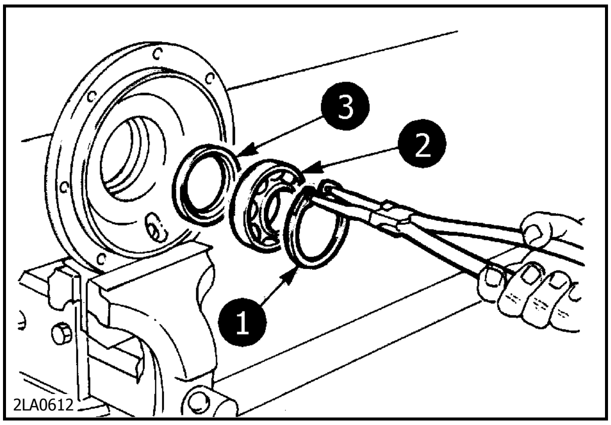
42

3. Remove the bevel gear (1) complete with bearing using a suitable puller.



43

4. Remove the inner spring ring (1) and then remove the bearing (2) and seal (3) from the relative housing.



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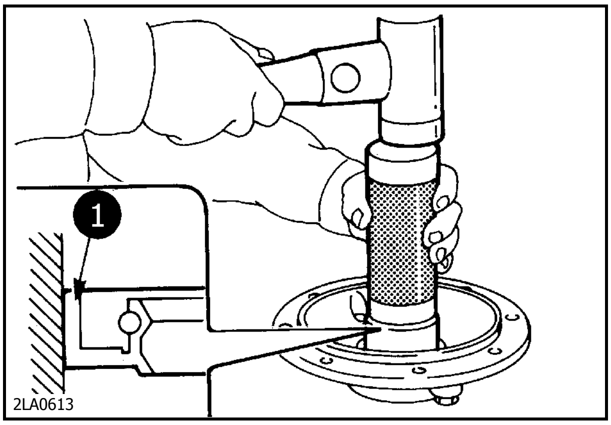
Assembly

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

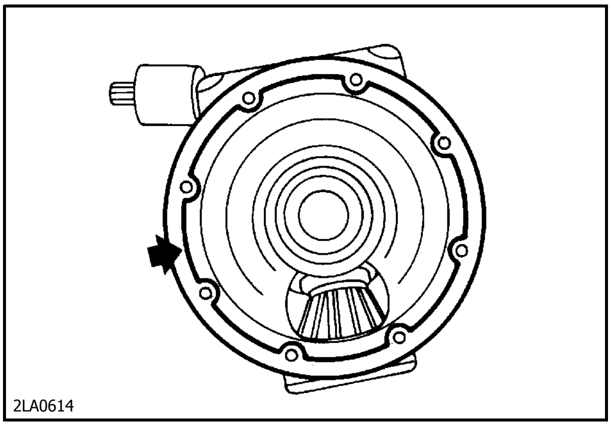
Remount the wheel hub bearing the following recommendations in mind:

- Refer to figs. 3 and 4.
- Refer to the driving torques listed on page 4.



45

- Mount a new seal (1) using a suitable tool and comply with the indicated position. Fill the cavity between the seal lips with the prescribed type of grease.
- Mount the bearing in the seat using a mallet and then mount the spring ring.
- Mount the wheel hub and then mount the bearing, the spacer and lastly the spring ring.
- Apply sealant all along the jointing edge between the hub housing and pivot pin, complying with the indications in the figure.
- Remount the complete wheel hub.



46

FRONT FINAL DRIVE – SPLITTING REMOUNTING

Splitting

DANGER

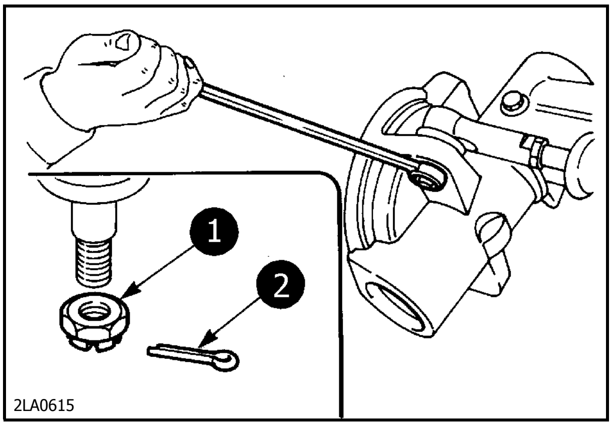
Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units or parts are supported by appropriately sized harness and hooks.
Make sure that there are no bystanders near the load being lifted.

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

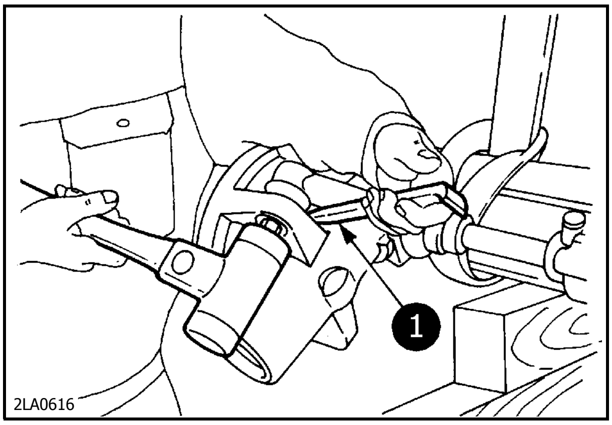
Proceed as follows:

1. Remove the split pin (2) and the lock nut (1).



47

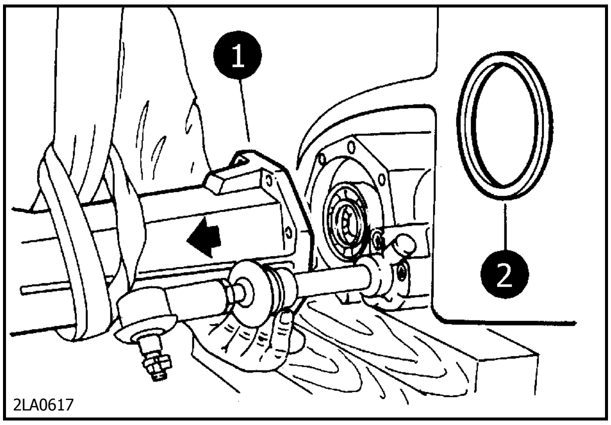
2. Remove the head from its seat using an appropriate lever (1).



48

3. Remove the axle breather (only from the right), then unscrew the fixing screws and remove the side housing (1). Recover the adjuster spacer (2).

> Take care of the differential assembly, which tends to be dragged out of the side housing.



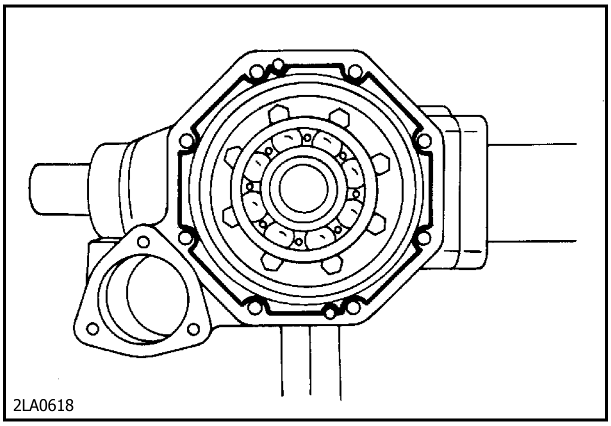
49

Remounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

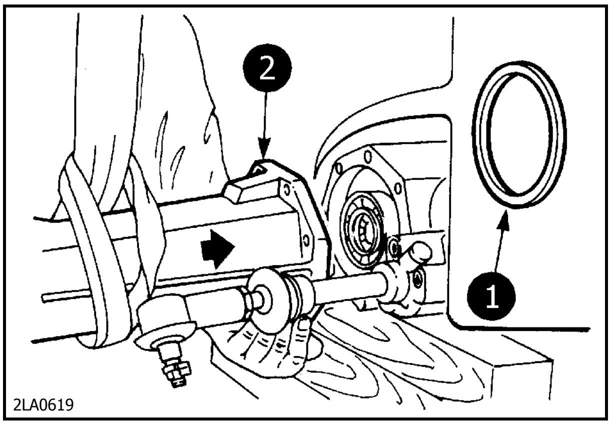
Remount the front final drive bearing the following recommendations in mind:

- Refer to figs. 2 and 3.
- Refer to the driving torques listed on page 4.
- Apply sealant all along the jointing edge between the side housing and central housing, complying with the indications in the figure.



50

- Mount the adjuster spacer (1) in the relative seat in the side housing (2), then mount this latter, taking care to center the differential bearing and then the centering pins.
- Mount the steering head in place with a new split pin.



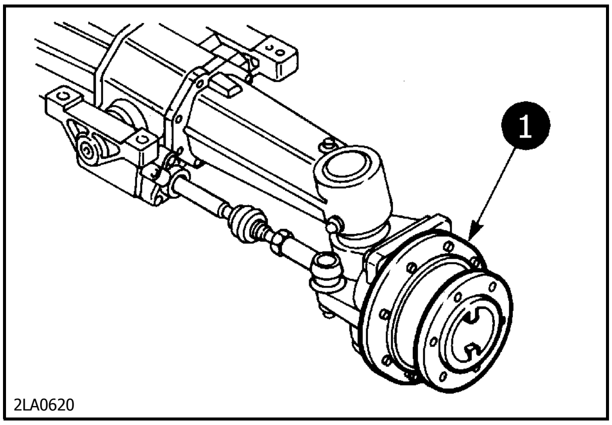
51

FRONT FINAL DRIVE - OVERHAUL

Demounting

DANGER

Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units or parts are supported by appropriately sized harness and hooks.
Make sure that there are no bystanders near the load being lifted.

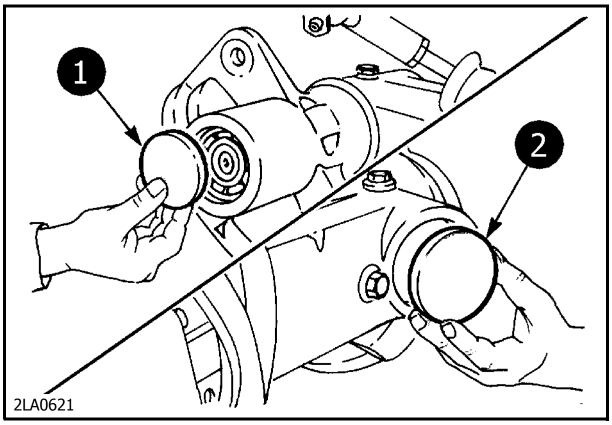


52

Proceed as follows:

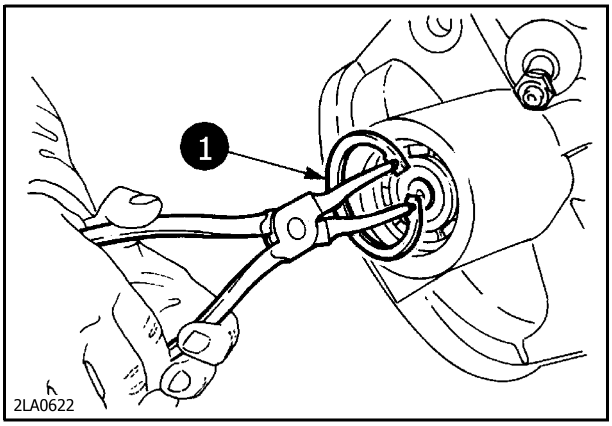
1. Remove the wheel hub.
2. Remove the lower (1) and upper (2) plugs using a suitable punch.

It is absolutely essential to replace the plugs.



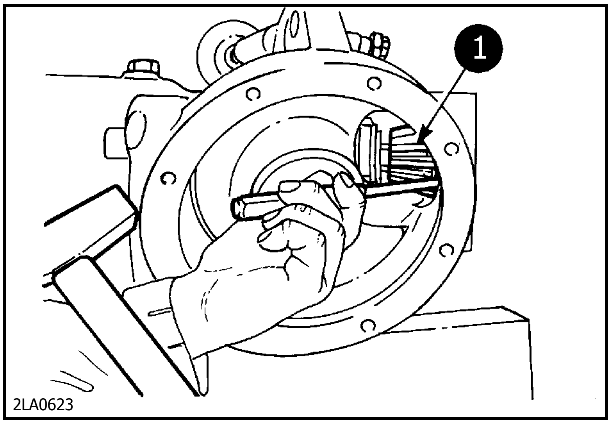
53

3. Remove the spring ring (1).



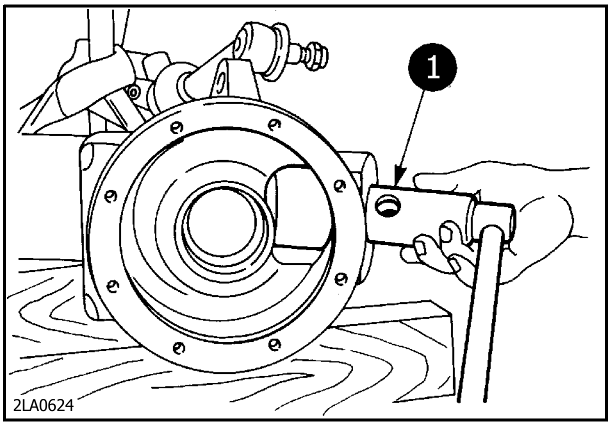
54

4. Remove the bearing and bevel pinion (1) using an adequate tool. Also remove the bearing from the pinion if necessary.



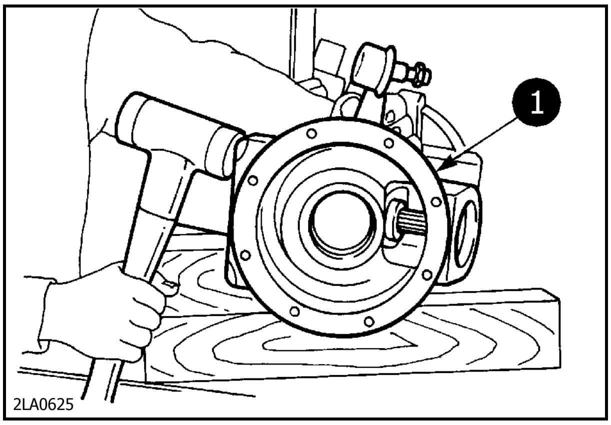
55

5. Remove the ring nut that locks the taper bearings with wrench **003 DT MIS** (1).



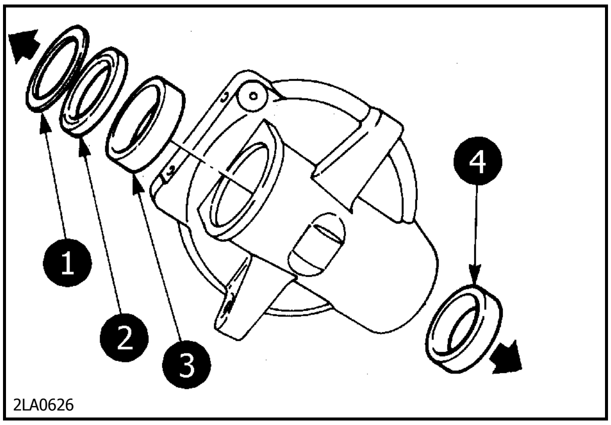
56

6. Support the pivot pin (1) in an adequate way, then remove it using a lever. Tap in carefully with a plastic mallet until the bearings have been freed. Remove both the inner bearing rings.



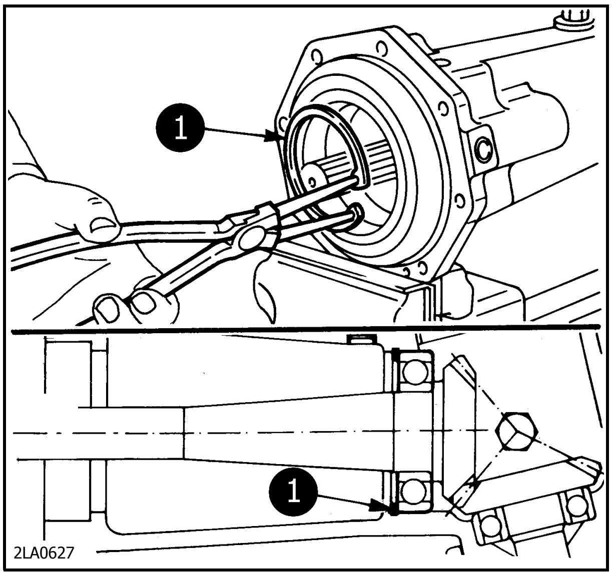
57

7. Remove the dust guard ring (1), the seal (2), the outer ring (3) of the upper bearing and the outer ring (4) of the lower bearing from the pivot pin.



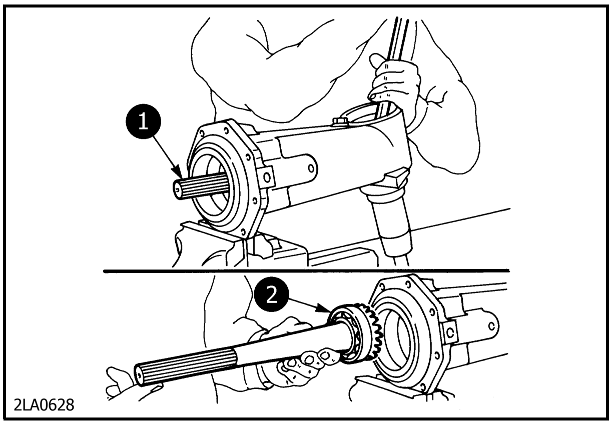
58

8. Remove the spring ring (1), using a pair of pliers for inner spring rings equipped with appropriate extensions.



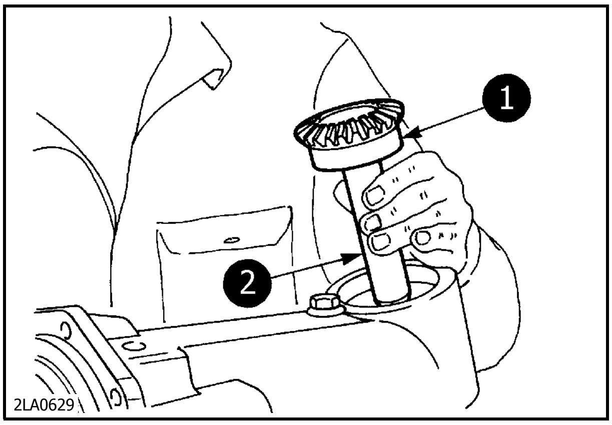
59

9. Remove the horizontal axle shaft (1) by levering on the bevel gear side. Remove the bearing if necessary.



60

10. Remove the vertical axle shaft (2) from above. remove the bearing (1) if necessary.



61

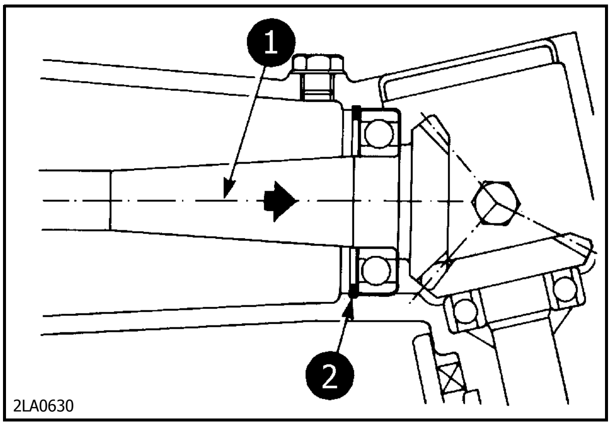
Assembly

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Remount the front final drive bearing the following recommendations in mind:

- Refer to figs. 3 and 4.
- Refer to the driving torques listed on page 4.
- Mount the vertical axle shaft complete with bearing.
- Mount the horizontal axle shaft (1) complete with bearing, pushing until the gears contact. Now lock it in place with the spring ring.



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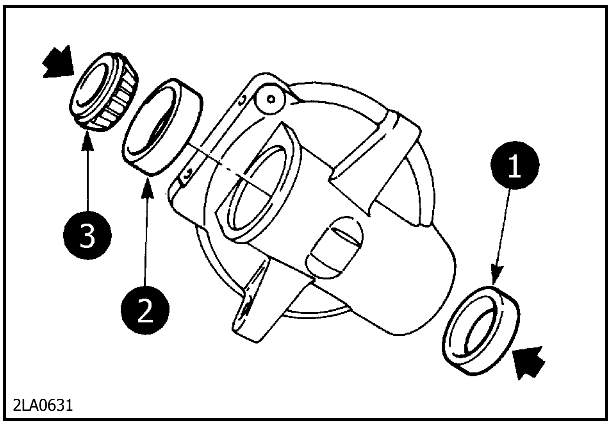
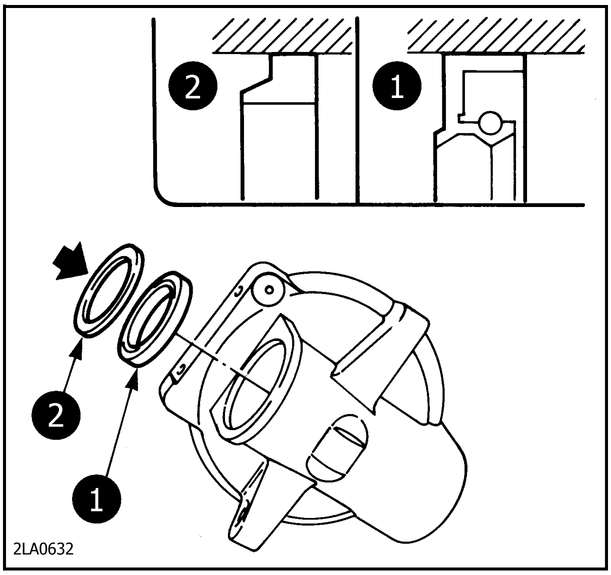
Take care to ensure that the bearing is correctly mounted on the axle shaft and the relative spring retainer ring on the side housing.

- Mount the outer ring of the lower bearing (1) and the upper bearing (2) in the pivot pin. Now mount the upper bearing (3).



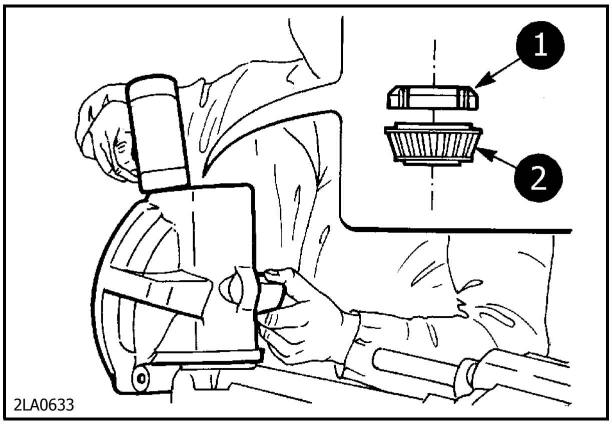
63

- Mount a new seal (1) and a new dust guard ring (2) using a suitable tool and comply with the indicated position. Fill the cavity between the seal lips with the prescribed type of grease.



64

- Mount the pivot pin with the utmost care until it is fully inserted. Now mount the inner ring of the lower bearing (1) and tighten the lock nut (2) without torquing.



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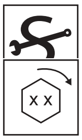
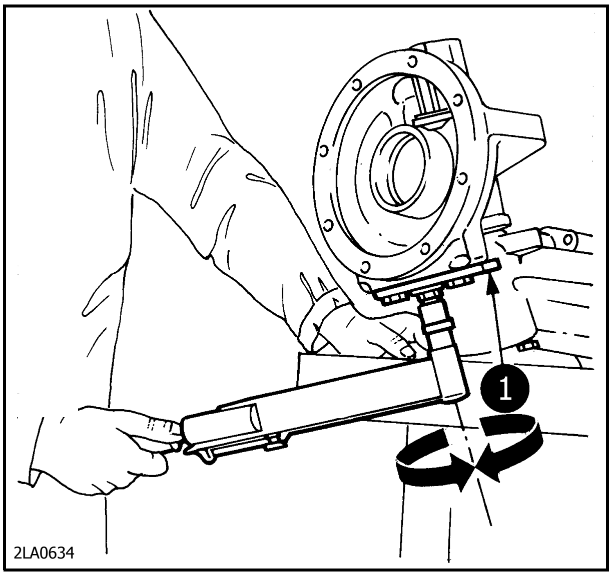


- Mount tool **004 DT MIS** (1) on to the pivot pin.
- Use a torque wrench to check that the rolling torque of the bearings is within the prescribed values.

Pivot pin bearing rolling torque: 15 - 20 Nm

- Adjust with the ring nut if this is not the case.



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- Remount the wheel hub.
- Mount the bevel pinion complete with bearing and fix it in place with the spring ring.
- Mount new closing plugs and apply sealant along the jointing edges.

AXLE STEERING CYLINDER – SPLITTING REMOUNTING

Splitting

DANGER

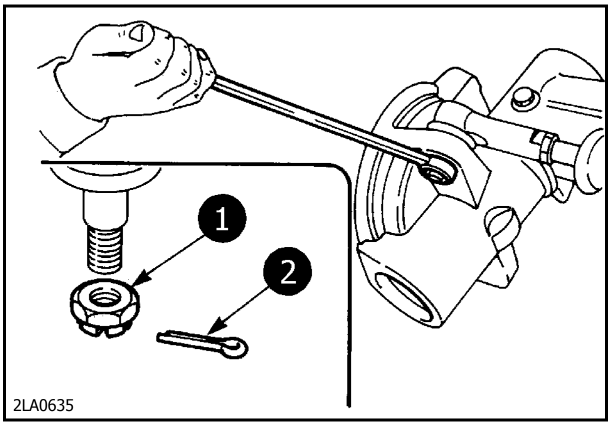
Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units or parts are supported by appropriately sized harness and hooks.
Make sure that there are no bystanders near the load being lifted.

WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

1. Remove the split pin (2) and the lock nut (1) from both sides.



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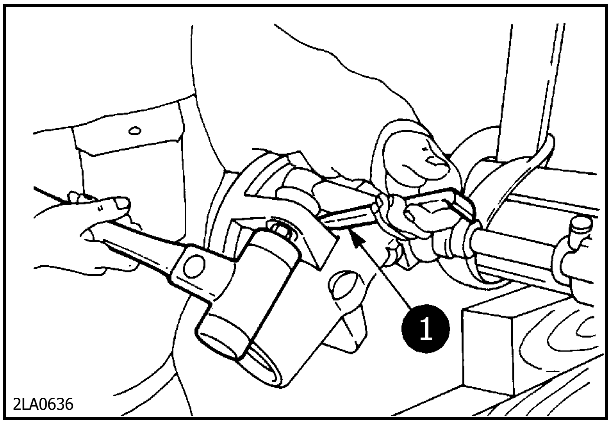
2. Remove the head from its seat using an appropriate lever (1) on both sides.



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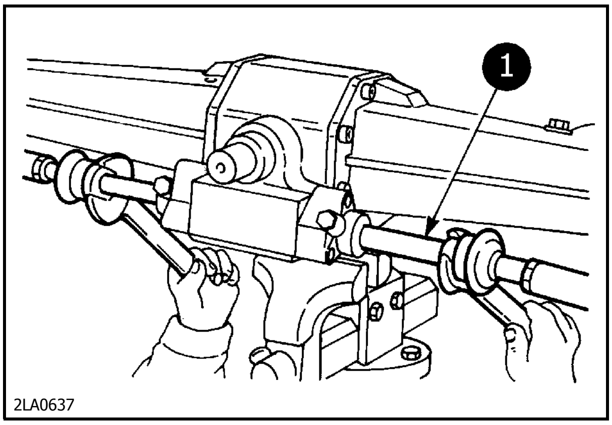
3. Remove the steering arm (1) from both sides.

> Do not touch the arm adjuster nut as this could lead to subsequent alignment operations being required.



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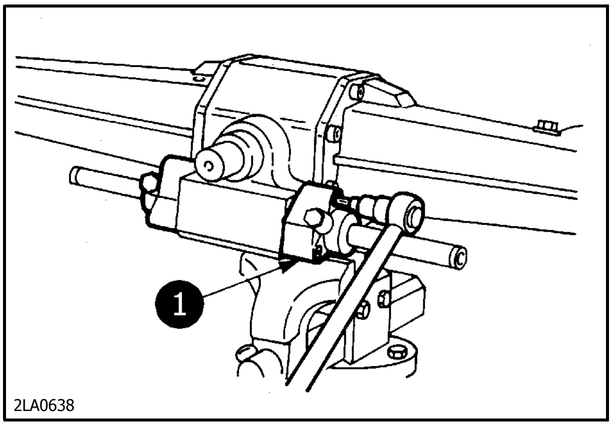
4. Unscrew the screws from both sides of the cover (1).



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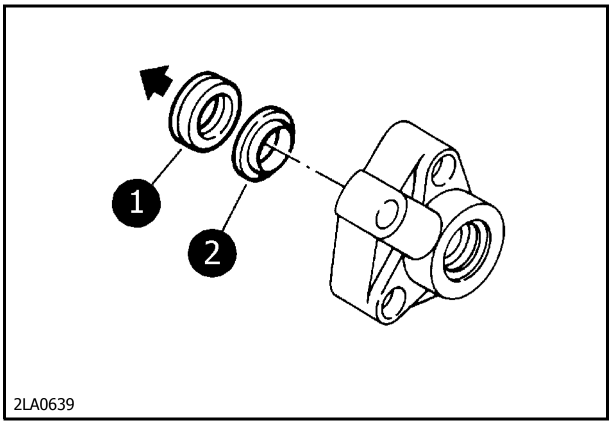
5. Remove the dust guard ring (1) and the seal (2) from both covers.



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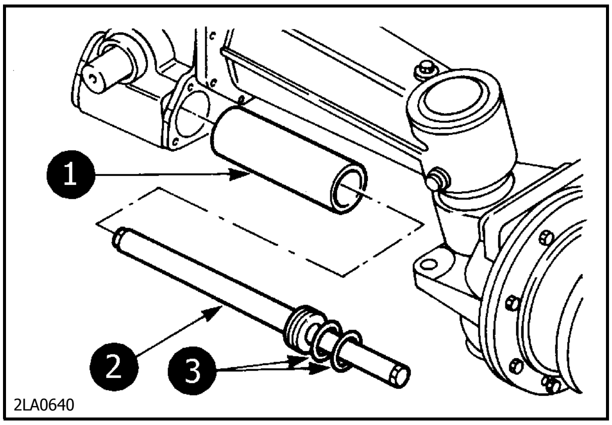
6. Take out the complete cylinder (1), then remove the rod (2) from it. Remove the retention rings (3) from the piston if necessary.

> The rod and the piston cannot be separated.



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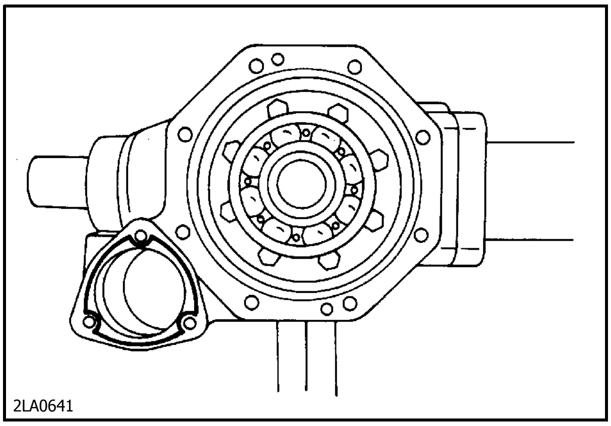
Remounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Remount the steering cylinder bearing the following recommendations in mind:

- Refer to figs. 2 and 3.
- Refer to the driving torques listed on page 4.
- Mount new retention rings on to the piston and reassemble the steering cylinder.
- Apply sealant all along the jointing edge between the central housing and cover, complying with the indications in the figure.



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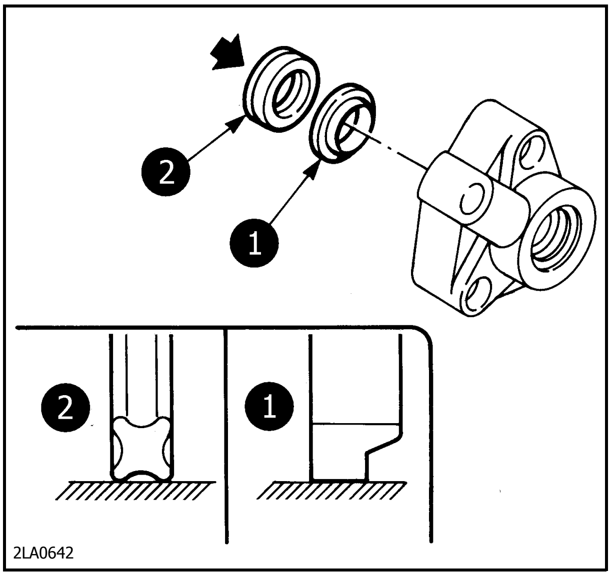
- Mount a new dust guard ring (1) and a new seal (2) using a suitable tool and comply with the indicated position. Fill the cavity between the seal lips with the prescribed type of grease, then mount the covers.
- Remove the steering arms from both sides.
- Mount the steering head from both sides and fix it in place with a new split pin.



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SECTION 600

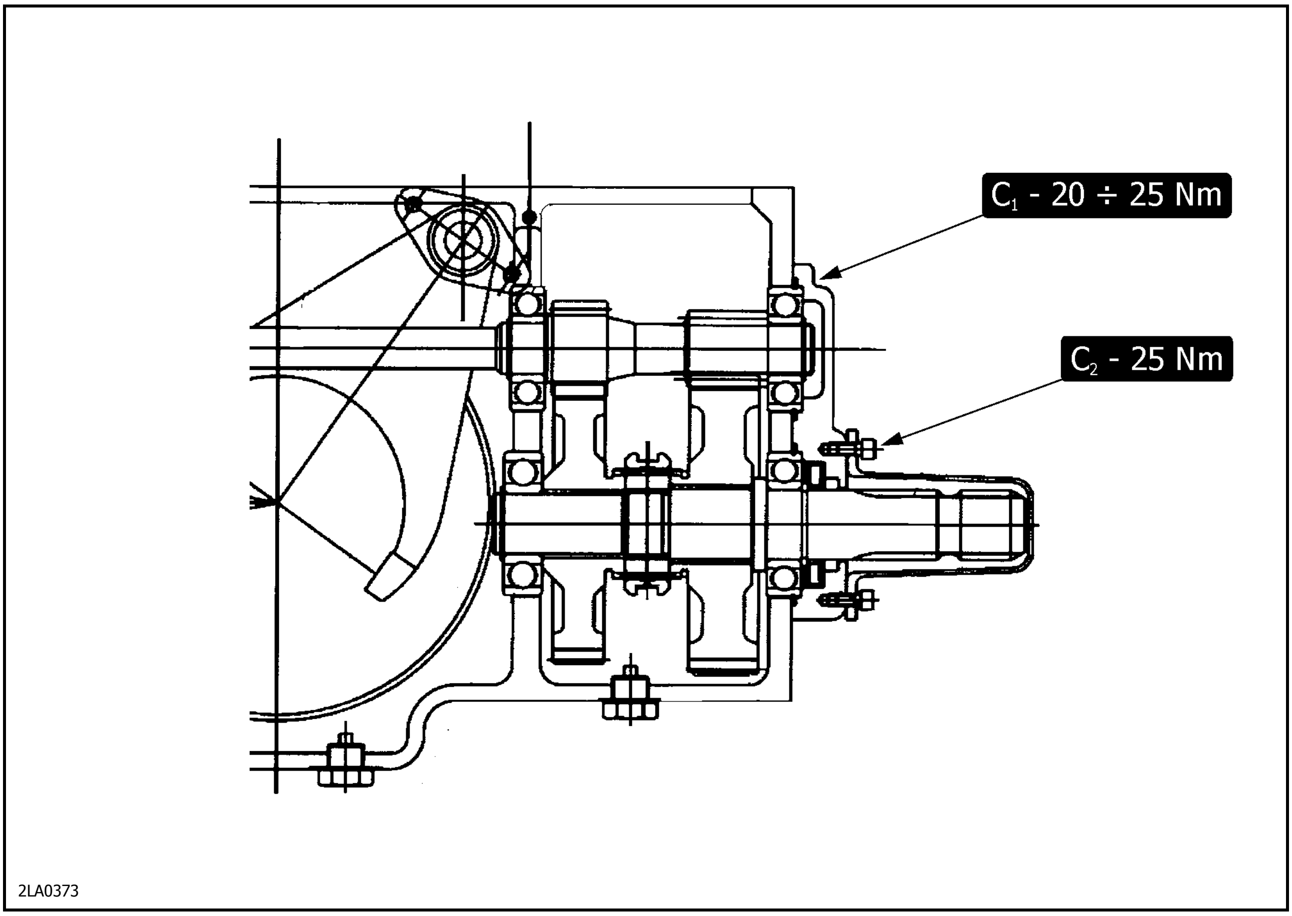
POWER TAKE-OFF

INDEX

MAIN SPECIFICATIONS

540/540E RPM power take-off		
Type (with two functions).		1) independent in relation to the tractor's ground speed or 2) synchronised with the gearbox
Engagement and control		mechanical, by means of a lever installed under the steering wheel and to the left of the driver's position
Speed selection.		by means of a lever installed on the left side of the platform
Spinning direction (tractor viewed from the rear)		clockwise
Engine rate with PTO at 540 RPM	(RPM)	2538
Engine rate with PTO at 540E RPM	(RPM)	1869
Diameter of the driven shaft on output spline shaft . . .		$1^3/_8$" (6 splines)
Rotation rate with 540E RPM PTO synchronized with the gearbox	(revs/wheel turn)	11.075

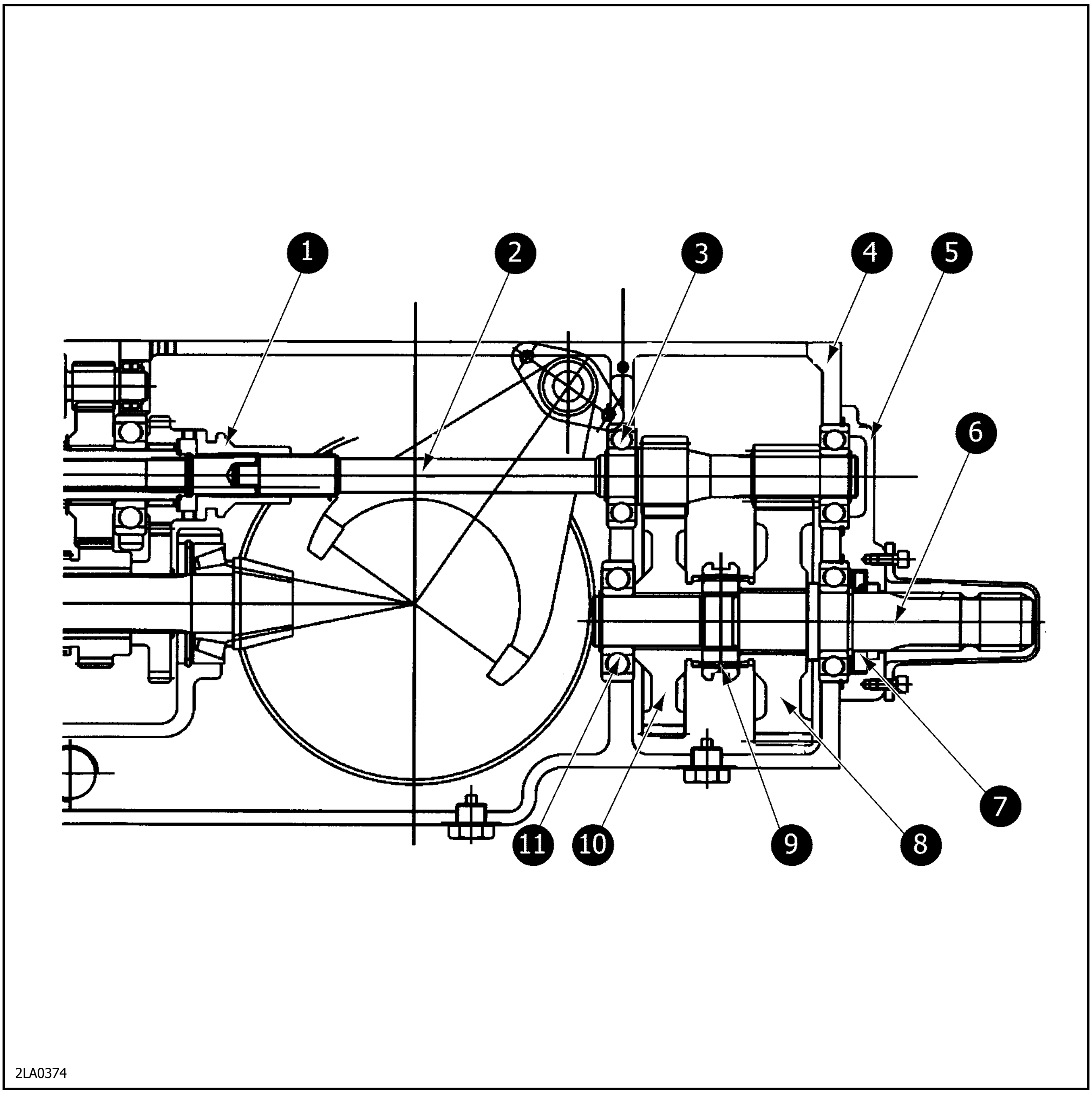
DRIVING TORQUE VALUES



1

PARTS TO TORQUE	Thread	Driving torque values	
		Nm	kgm
PTO cover fixing screws (C_1)	-	20 - 25	2 – 2.5
PTO shield fixing screws (C_2)	M 8 x 1.25	25	2.6

SECTIONS



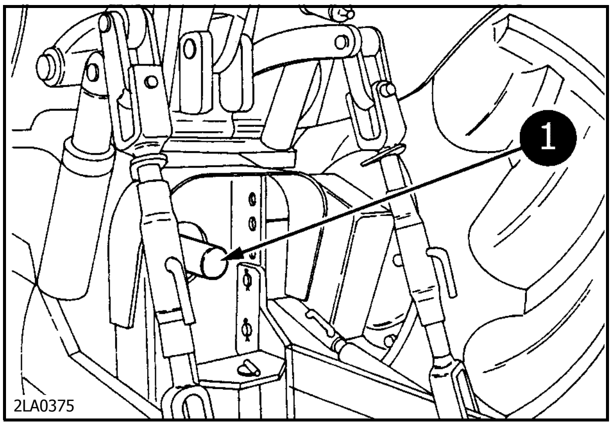
2

Longitudinal section of the 540/540E power take-off

1. Sliding sleeve
2. Upper PTO shaft
3. Ball bearing.
4. Rear transmission housing
5. Cover
6. PTO output shaft
7. Retention ring
8. 540 RPM gear
9. Meshing sleeve
10. 540 E RPM gear
11. Ball bearing.

DESCRIPTION AND OPERATION

The output shaft of the power take-off is mounted in the rear part of the tractor and transfers drive from the engine to the mounted or towed implements. It can either be controlled directly by the engine (independent PTO) or directly by the gearbox (PTO synchronized with the tractor's ground speed).
All tractors are equipped with a two-speed PTO, i.e. 540/540E RPM, with mechanical engaging/disengaging control.

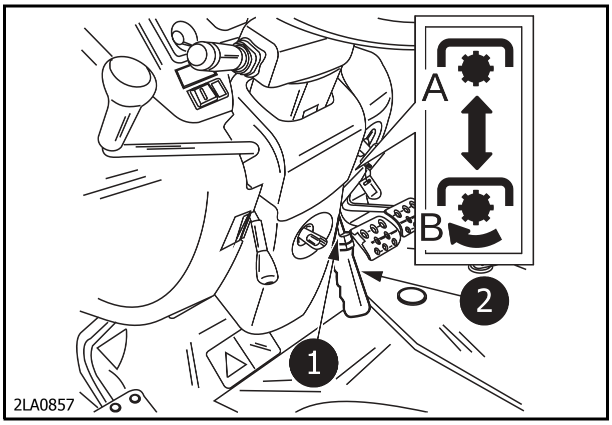


3

Power take-off controlled directly by the main clutch

Proceed in the following way to operate the independent PTO:

- press the button (1) to release the clutch lever (2);
- move the lever fully up until the disengaging position is obtained;
- select the rotation speed for the spline shaft by means of the lever (1, fig. 6);
- select the operating mode by moving the lever (1, fig. 5);
- pull the lever (1) and press the button (2) to release the lever;
- move the lever (1) fully down to the engaging position.



4

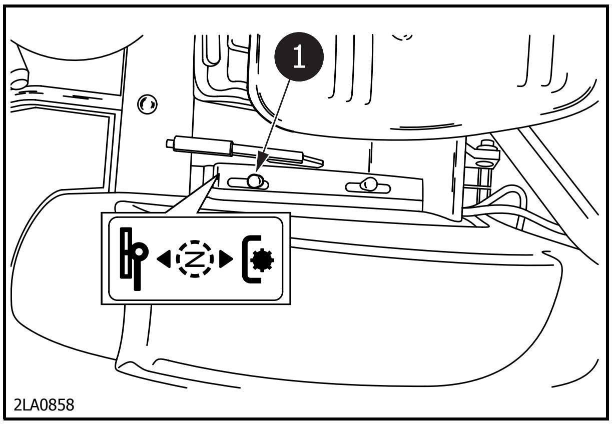
In these conditions, operation is fully independent from the ground speed of the tractor. The operator can therefore:

- stop the tractor without stopping the PTO;
- stop the PTO without stopping the tractor (by disengaging the PTO clutch).

The direction in which the end part spins is clockwise, with the tractor viewed from the rear.

Just move the lever up (1, fig. 5) to disengage the PTO.

> **!** Only keep the lever in the disengaging position for the time it takes to make the manoeuvres. Always keep the lever in the engaged position during work.



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> **WARNING**
> Always disengage the PTO when you get off the tractor.

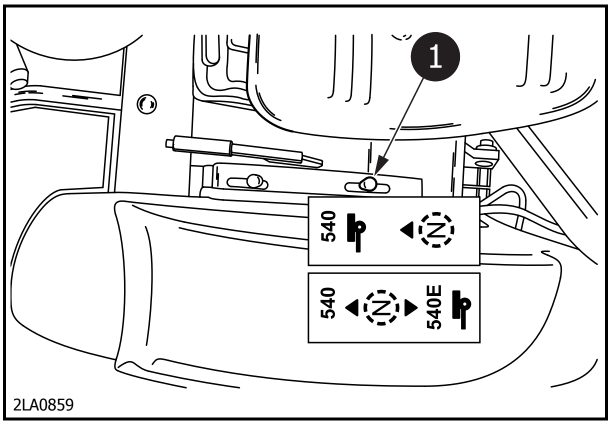
Power take-off rates:

power take-off selected: 540 RPM (Excluding North America)

- 540 RPM with engine at: 2538RPM
- 595 RPM with engine at: 2800RPM

power take-off selected: 540 E RPM

- 540 E RPM with engine at: 1869RPM
- 630 RPM with engine at: 2181RPM



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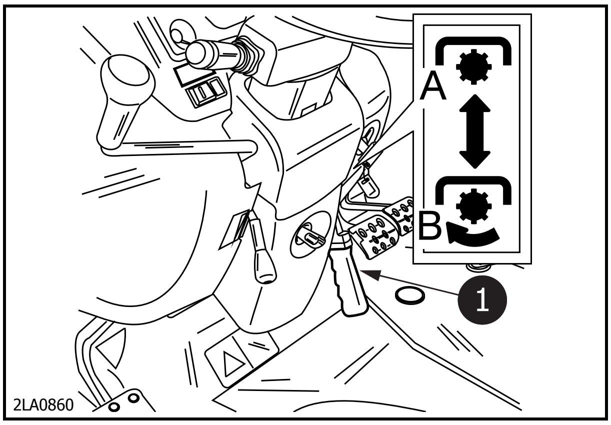
Power take-off synchronized with the gearbox

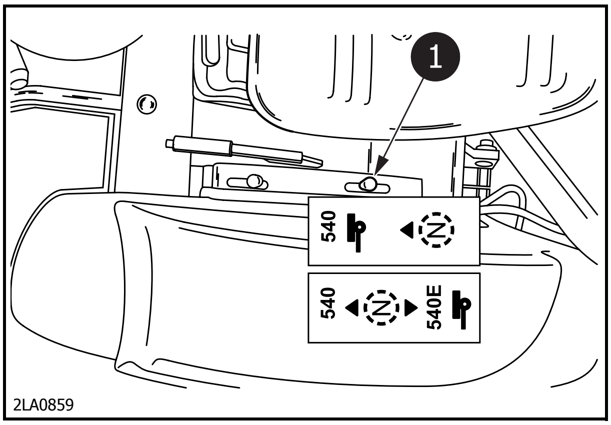
The function whereby the power take-off is synchronized with the gearbox is used to tow trailers or implements with drive transmitted to the wheels. It is also used for implements that must work in synchronism with the ground speed of the tractor and that do not require more than 40-45% of the tractor power. Only select the 540 E speed with the synchronized PTO. Engage the synchronized PTO when the tractor is at a standstill.



7

Proceed in the following way to select the synchronized PTO:

- stop the tractor but keep the clutch pedal depressed;
- move the lever (1, fig. 7) up to disengage the PTO clutch;
- select the 540 E speed; lever (1) back;
- push the lever (1, fig. 9) forwards to select the synchronized PTO mode;
- move the lever (1, fig. 7) down to engage the PTO clutch;



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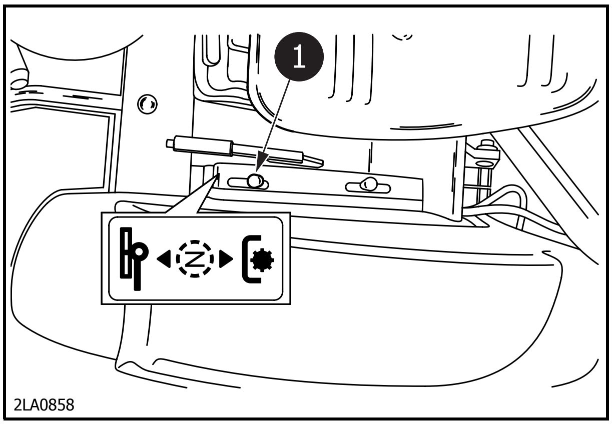
> When the tractor is reversed and the synchronized PTO is engaged, the PTO shaft will turn in the opposite direction. Always remember to disengage the PTO to prevent the implement connected from being damaged.

Whatever speed gear is engaged, the PTO output shaft **spins 11.075 revolutions for each turn of the rear wheels.**



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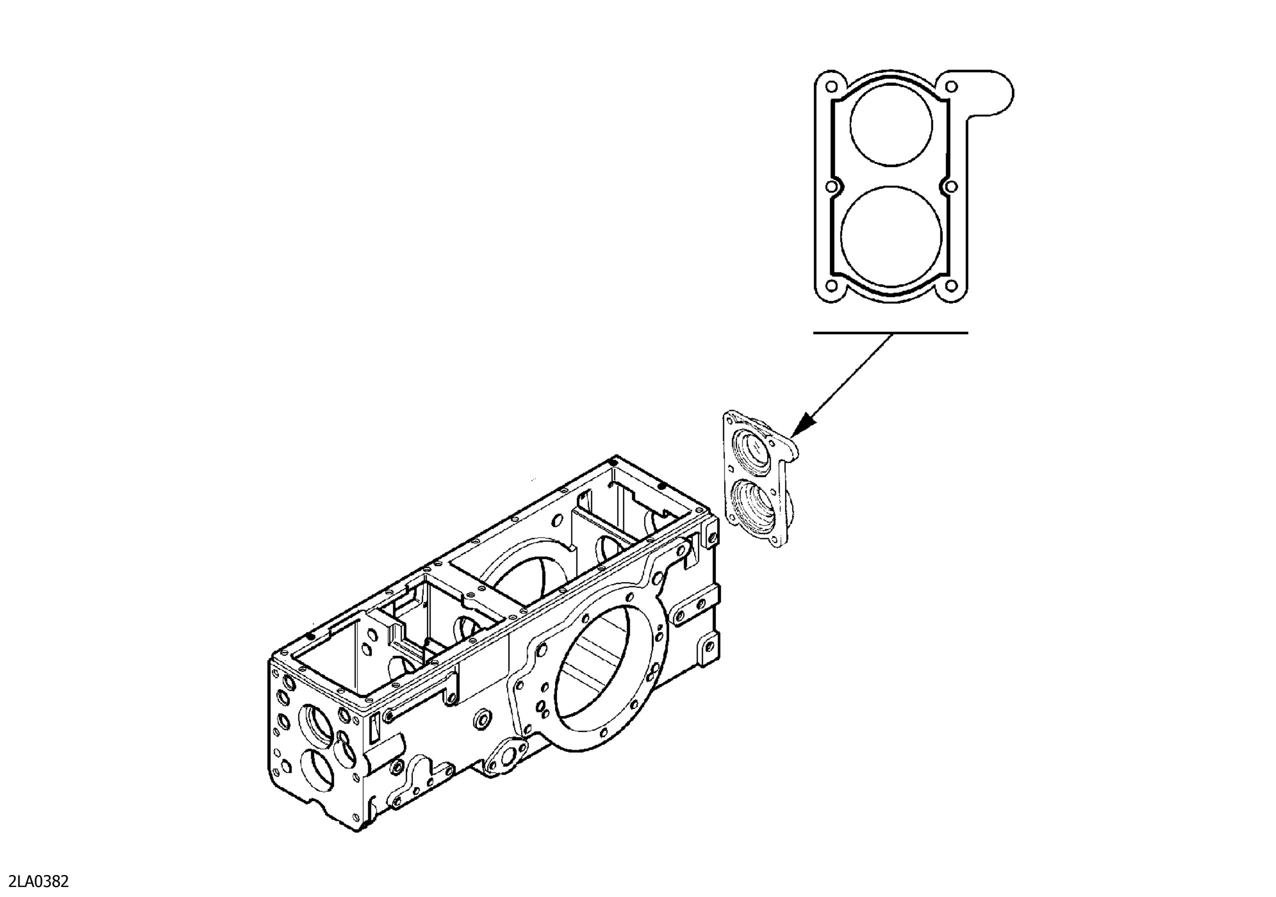
TROUBLESHOOTING FOR THE MECHANICALLY ENGAGED POWER TAKE-OFF

Faults	Possible causes	Remedies
The spline shaft on the PTO output slips with relative loss of speed.	Wear on the clutch plate or on the pressure plate of the flywheel. PTO clutch lever badly adjusted.	Compare with the values given in the relative pages in sect. 18. Replace excessively worn parts and adjust the clutch control lever.
It is difficult to select the PTO speed by means of the lever lever (1, fig. 6);	The external control has hardened or is badly adjusted.	Lubricate the control levers. Adjust the control.

WHERE THE SEALANT IS APPLIED ON THE POWER TAKE-OFF COVER



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The types of sealant to apply are indicated in section 100.

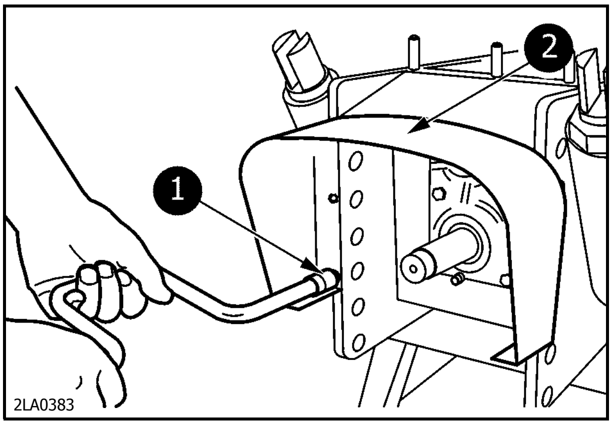
MECHANICALLY ENGAGED POWER TAKE-OFF OVERHAUL

Demounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

1. Split the gearbox-rear transmission housing.
2. Unscrew the fixing screws (1) and remove the shield (2) from the PTO shaft.



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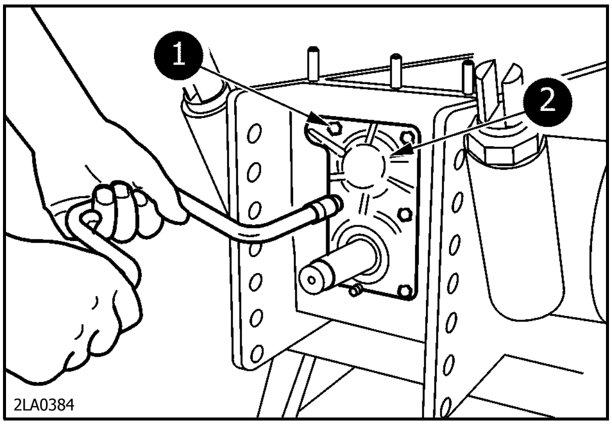
3. Unscrew the fixing bolts (1) and remove the cover (2) from the PTO shaft.



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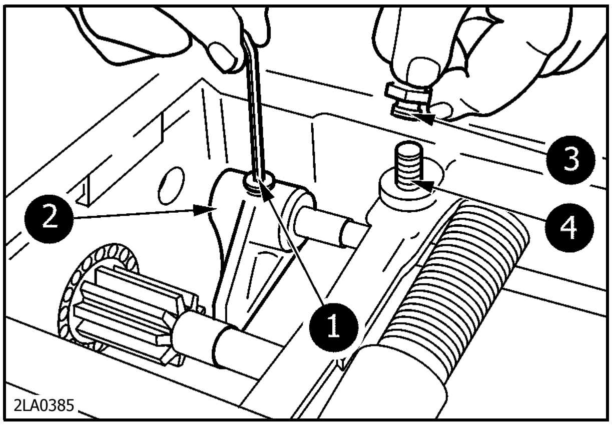
4. Unscrew the locking screw (1) of the fork (2). Unscrew the plug (3), remove the spring (4) and the rod retainer ball.



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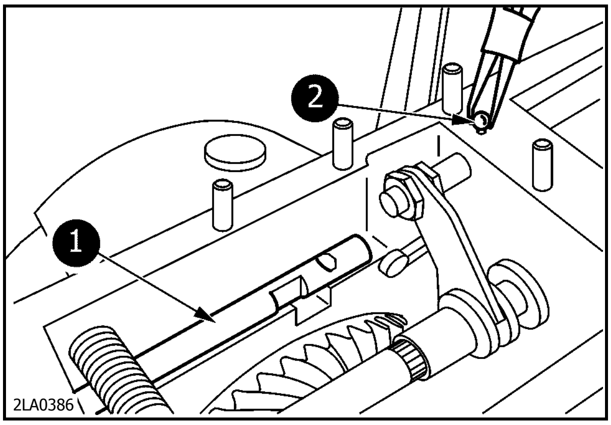
5. Remove the PTO speed selection rod (1). Recover the pawl (1) positioned between the speed selector rod and the PTO engaging rod.



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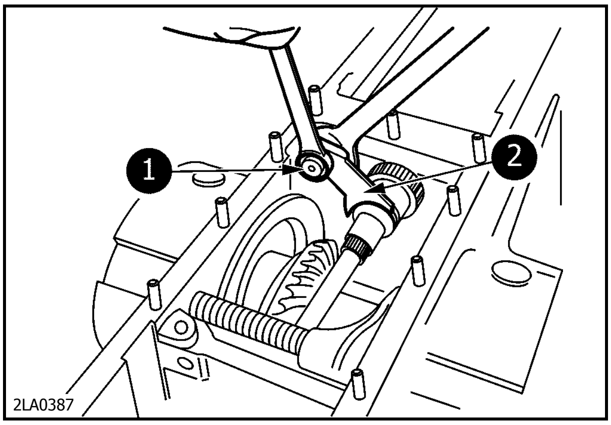
6. Unscrew the locking nuts (1) of the fork that engages the PTO (2) and remove it..



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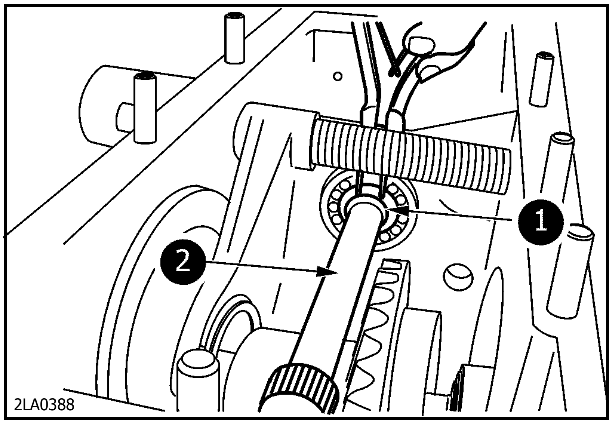
7. Remove the spring retention ring (1) and take out the driving gear (2).



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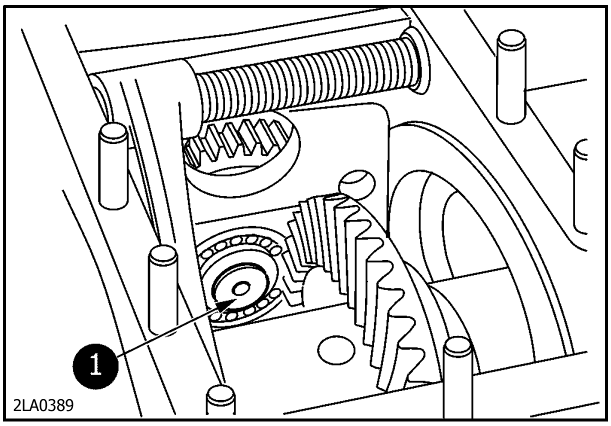
8. Remove the spring retention ring (1) that holds the PTO shaft.



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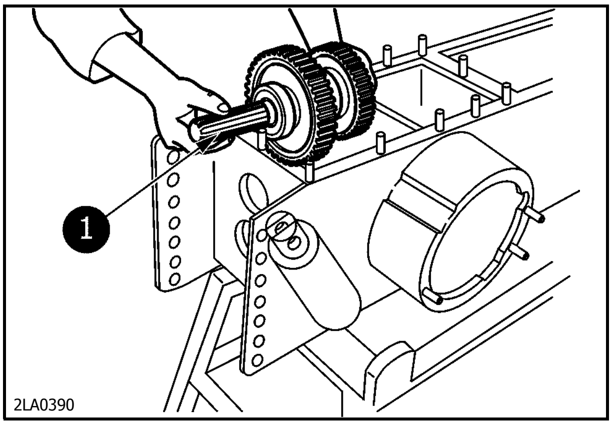
9. Remove the PTO shaft from the gearbox-transmission housing along with the relative gears (1).



18

Assembly

WARNING
Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Comply with the following recommendations when remounting the PTO:

- Comply with fig. 2 when positioning the various parts;
- Before remounting the housings, support and cover, thoroughly clean and degrease the coupling surfaces and apply a strip of sealant about 2 mm in diameter as indicated in fig. 10.
- Refer to the driving torques listed on page 4;
- Mount the PTO shaft complete with gears;
- Position the spring retention ring of the PTO shaft;
- Insert the driving shaft and position the spring retention ring;
- Insert the lock the PTO engaging fork;
- Mount the PTO speed selector rod with the relative retainer pawl;
- Position and lock the PTO speed engaging fork;
- Fit on the cover of the PTO;
- Mount the shield of the PTO;
- Remount the gearbox-rear transmission housing.

SECTION 700

HYDRAULIC CIRCUITS - REAR POWER LIFT

INDEX

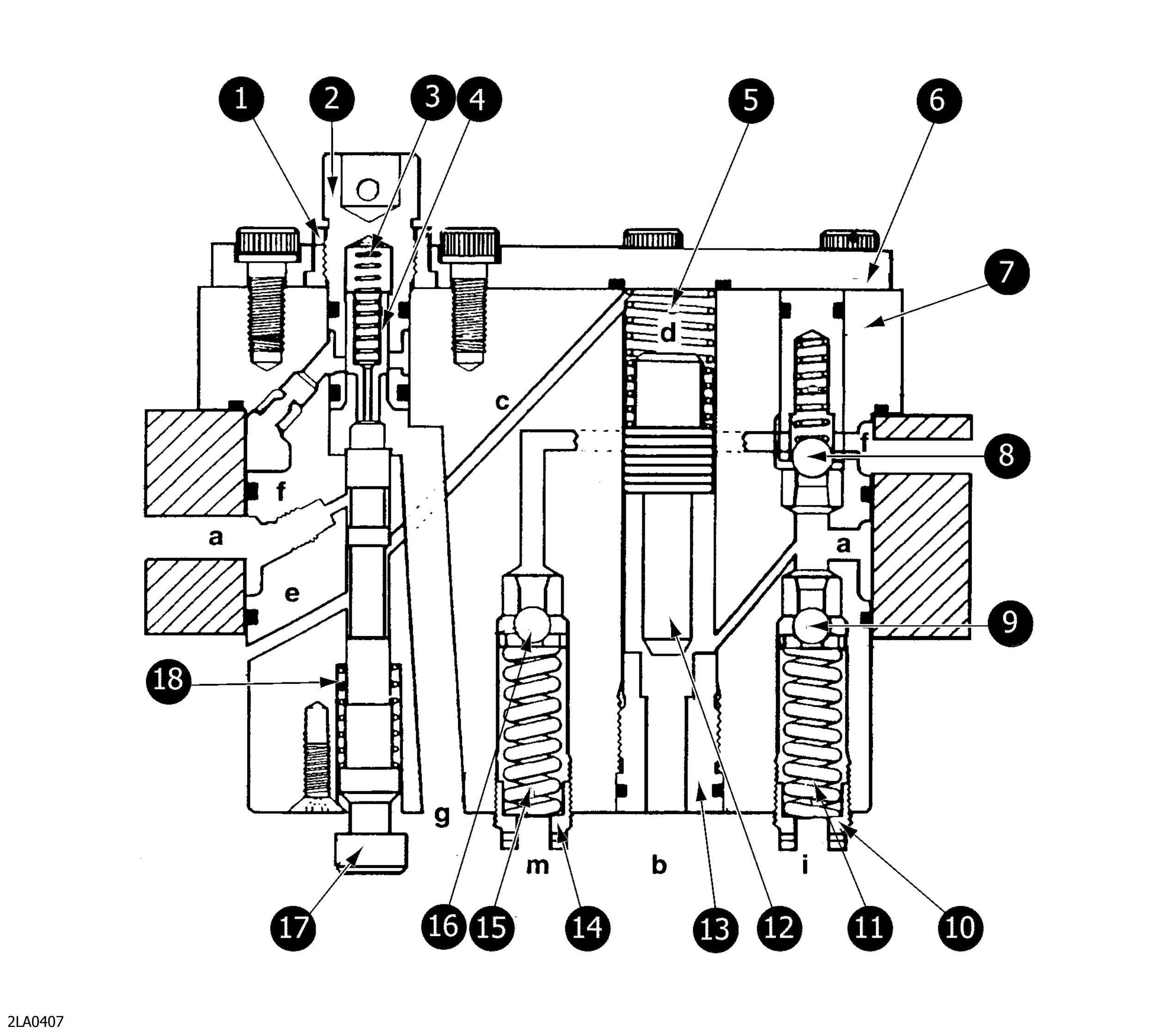
MAIN SPECIFICATIONS – REAR HYDRAULIC POWER LIFT

Mechanical Hydraulic Power Lift		
Make		Landini
Operating modes		Position/draft control intermix/floating mode
Hydraulic system		Open-center type
Cylinders		2 single-acting
Dimensions	(mm)	∅ 45 x 145 stroke
Over-pressure valve	(bar)	185 - 190
Cylinder safety valve	(bar)	200 - 205
Lifting capacity		
At ball ends with lower links horizontal	(kg)	1200

SPECIFIC EQUIPMENT

Code	Description
001 IDR MIS	Valve system support for bench tests
002 IDR MIS	High pressure pump for bench tests
003 IDR MIS	Draft control adjuster lever
004 IDR MIS	Pressure gauge union

SECTIONS AND PERSPECTIVE VIEWS

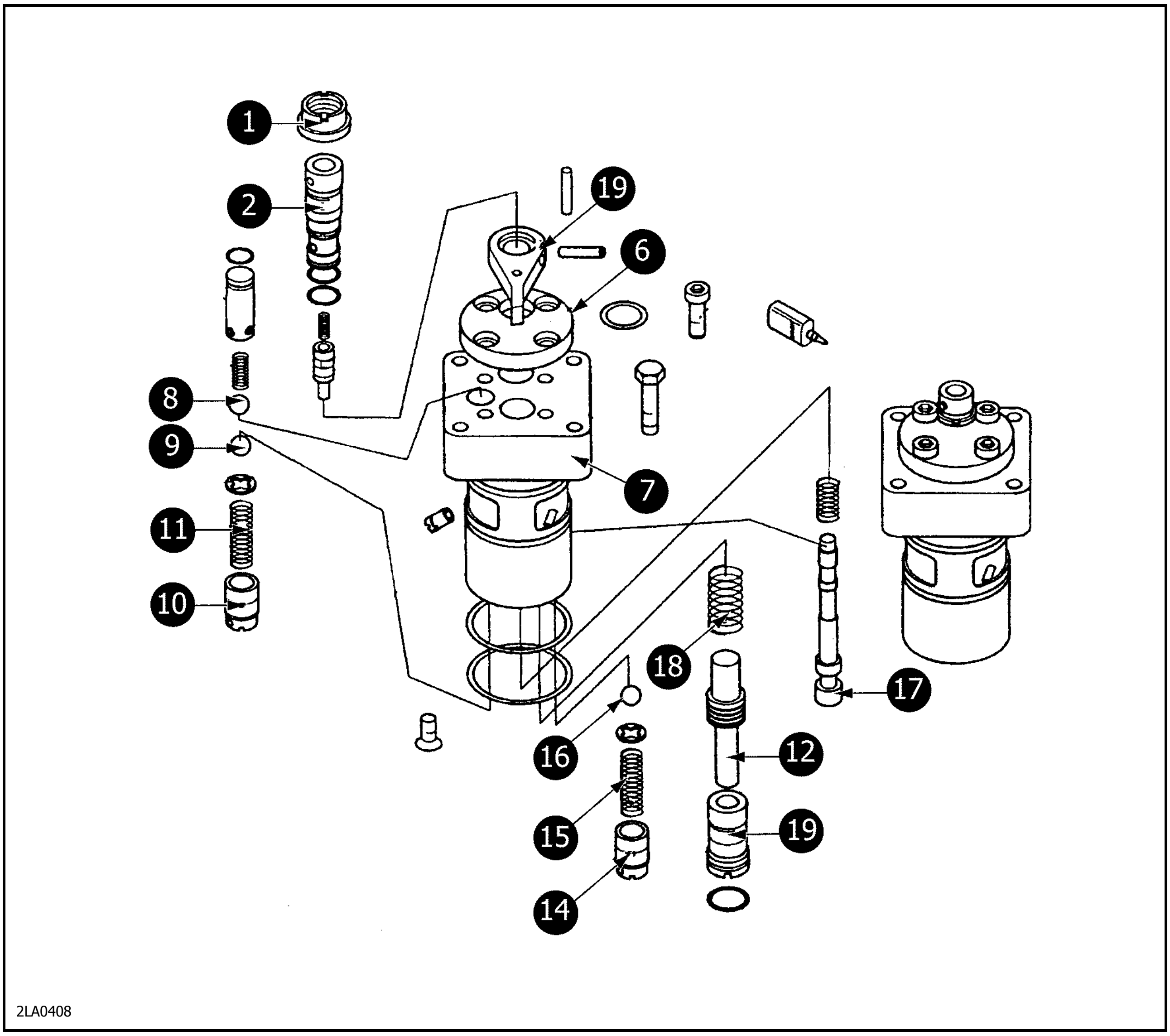


1

Longitudinal section of hydraulic power lift

1. Discharge valve ring nut
2. Discharge valve casing
3. Discharge valve spring
4. Discharge valve plunger
5. Servo valve spring
6. Cover
7. Valve system casing
8. Non-return valve ball
9. Over-pressure valve ball
10. Over-pressure valve adjuster plug
11. Over-pressure valve spring
12. Servo valve
13. Valve housing
14. Safety valve adjuster plug
15. Valve spring
16. Safety valve ball
17. Valve stem
18. Stem spring

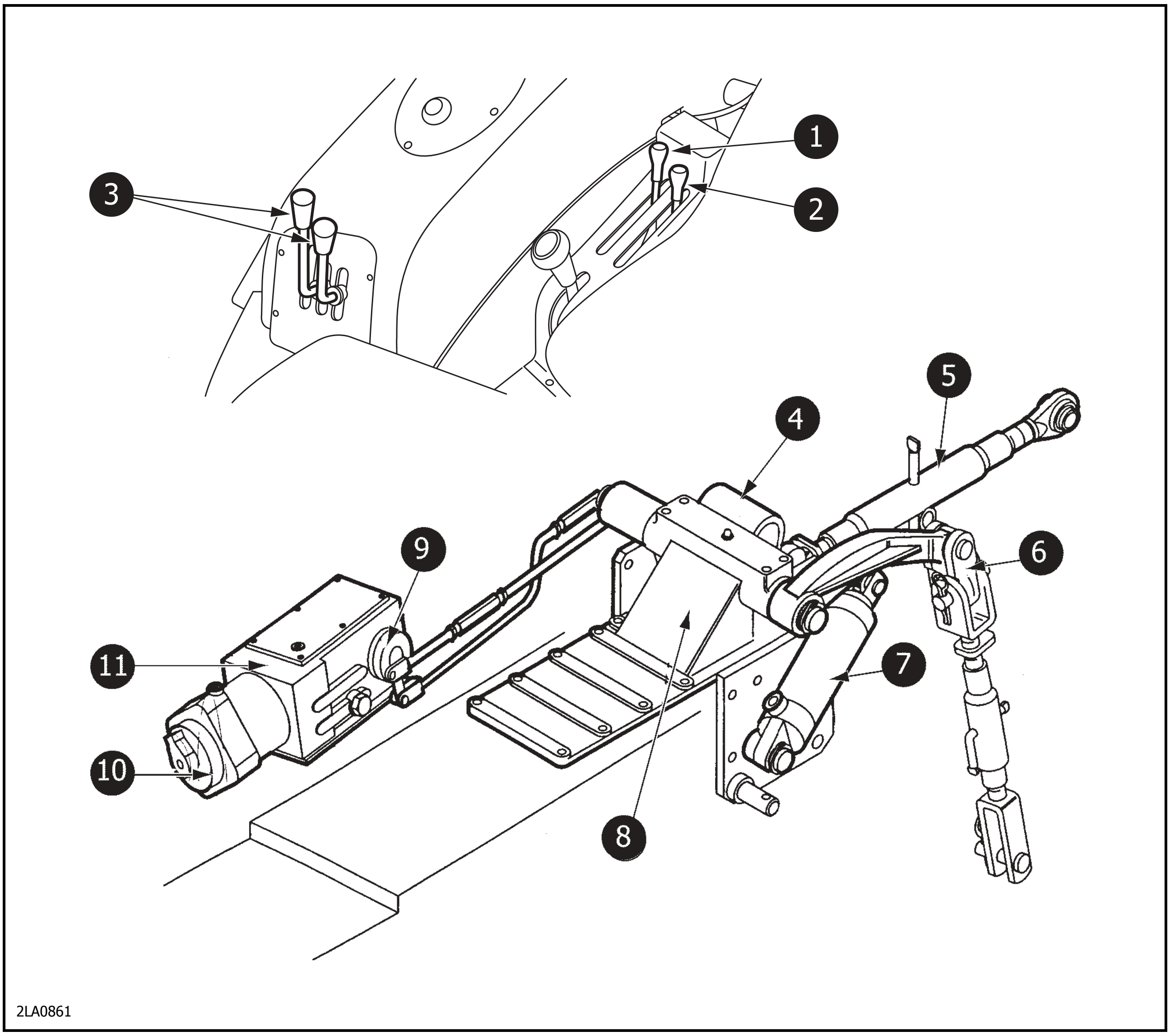
- **a.** Duct where oil arrives from pump
- **b.** Pump outlet
- **c.** Servo valve pilot duct
- **d.** Servo valve piloting pressure chamber
- **e.** Servo valve piloting outlet
- **f.** Duct delivering oil to the cylinder
- **g.** Duct discharging oil from the lifting cylinder
- **i.** Maximum valve outlet
- **m.** Antishock valve outlet



2

Perspective view of hydraulic power lift

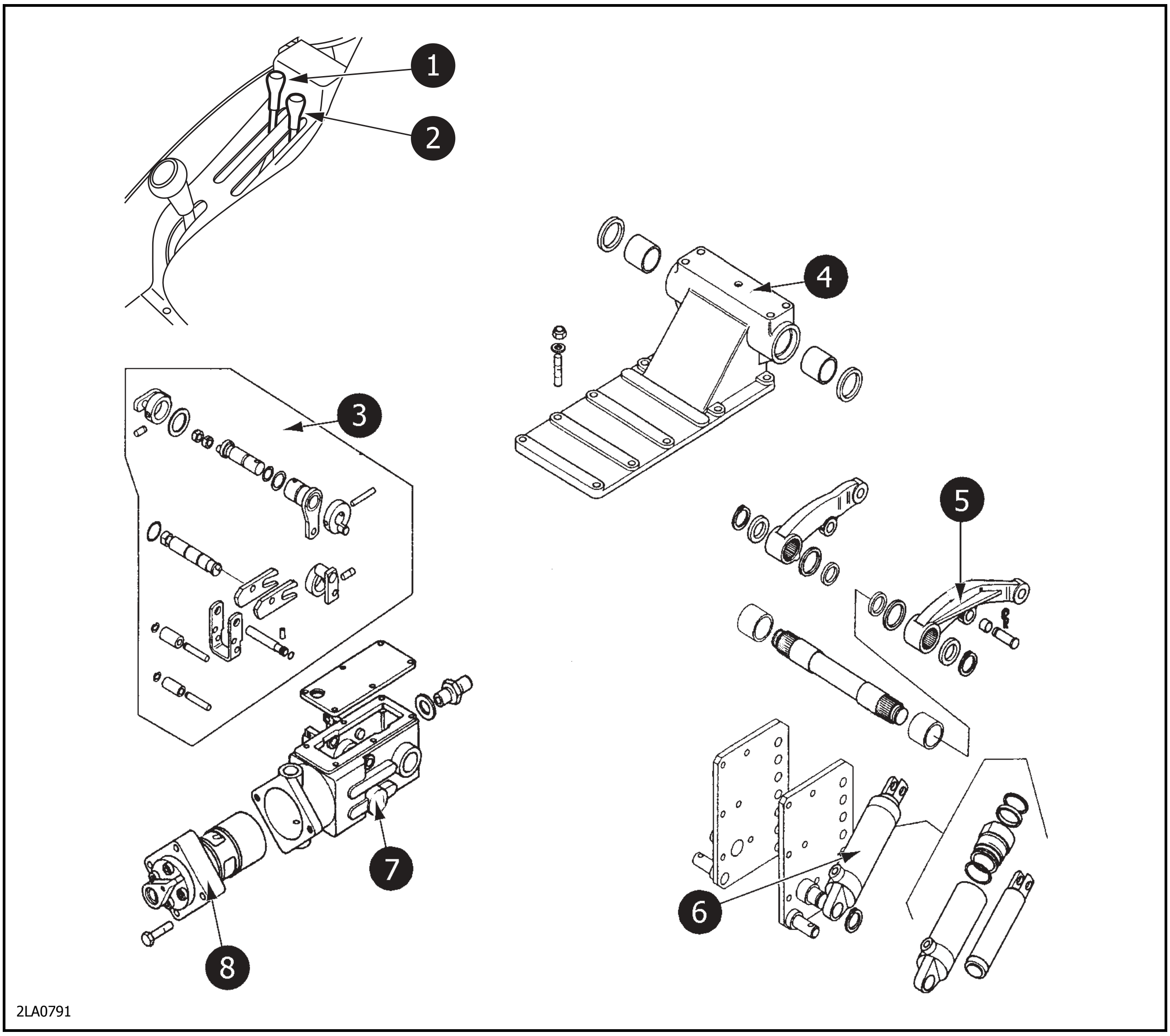
1. Discharge valve ring nut
2. Discharge valve casing
6. Cover
7. Valve system casing
8. Non-return valve ball
9. Calibration valve ball
10. Over-pressure valve adjuster plug
11. Calibration valve spring
12. Servo valve
13. Valve housing
14. Safety valve adjuster plug
15. Valve spring
16. Safety valve ball
17. Valve stem
18. Stem spring
19. Adjuster lever



3

Perspective view of the main components

1. Position/draft control lever
2. Position control lever
3. Auxiliary control valve lever
4. Reaction spring
5. Third point
6. Link
7. Cylinder
8. Power lift unit
9. Control lever unit
10. Hydraulic valve system
11. Housing of the control lever unit



4

Exploded view of the main components

1. Draft control lever
2. Position control lever
3. Control lever unit
4. Power lift unit
5. Link
6. Cylinder
7. Casing of the control lever unit
8. Hydraulic valve system

DESCRIPTION OF THE OPERATING MODE OF THE HYDRAULIC POWER LIFT

The hydraulic power lift may have four operating modes:

Position control

Draft control

Mixed control

Floating position

Each of these four operating modes must be chosen to suit the type of job and the surface consistency of the soil.

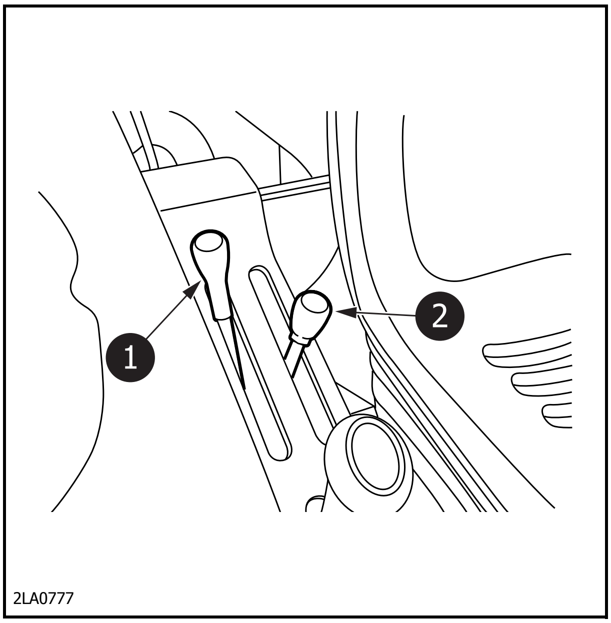
Position control

To work in the position control mode, move the draft control lever (1) up on the sector and establish the work depth with the position control lever (2).

The position control mode allows the implement to be set at a determined position at any point between the highest and lowest settings, both in and out of the soil, depending on the position to which the control lever is set.

Lifting link movement in height is proportional to the movement of the control lever.

The depth at which the implement works will not change even if it encounters soil of a different consistency (example: zone d = sandy soil; zone e = compact soil; zone c = clayey soil).



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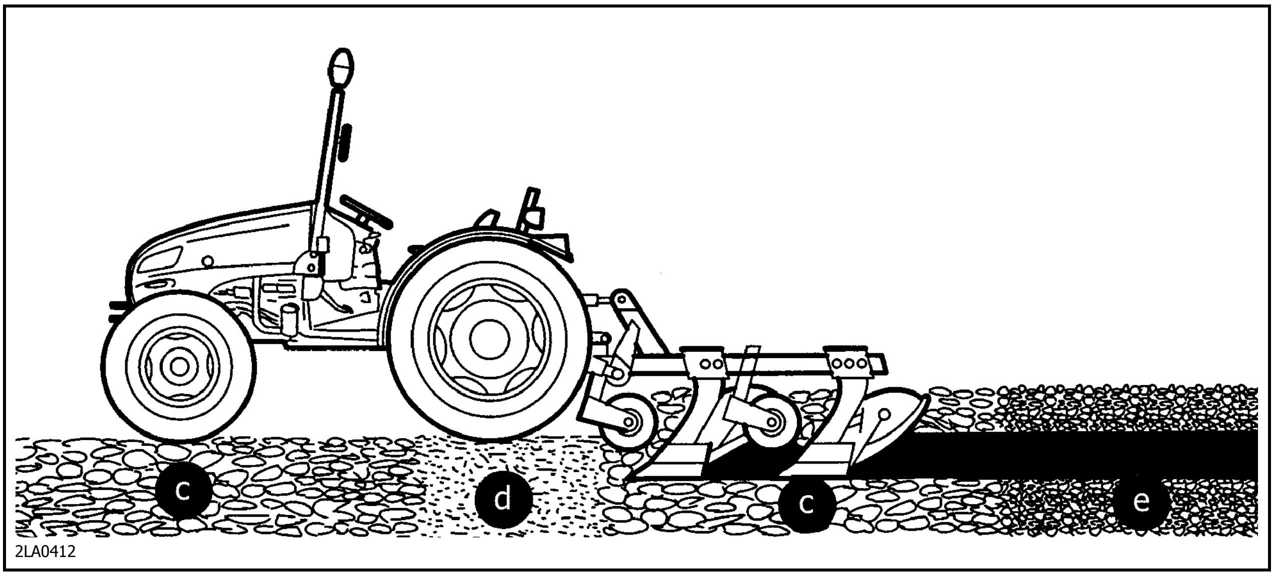

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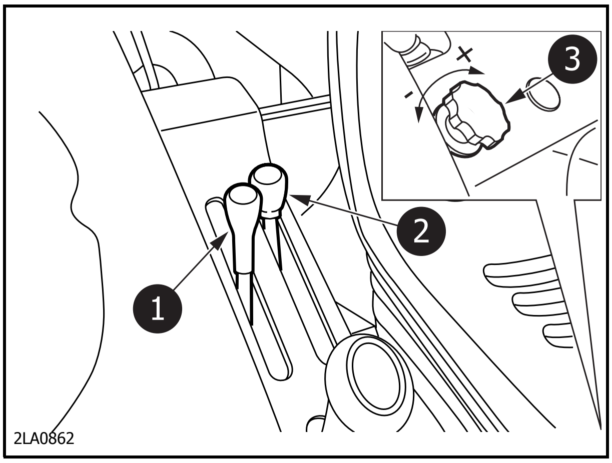
Draft control

To work in the draft control mode, move the position control lever (1) fully up on the sector and establish the work depth with the draft control lever (2). The draft control mode allows the tractor's lugging power to be maintained at a constant level, automatically varying the work depth of the implement as the soil conditions change. In this operating mode, the depth at which the implement works may change to a considerable degree if it encounters soil of a different consistency (e.g.: zone d = sandy soil; zone e = compact soil), while the depth remains more or less uniform if the soil is homogeneous (zone c = clayey soil), whether the land is flat, or with hollows and hillocks.

Use of the draft control mode is of particular use during work that requires considerable lugging power carried out with mounted implements, since these transfer most of this lugging power to the rear wheels, thus increasing the tractor's wheel grip.

The lever (4) regulates the sensitivity of the response in draft control mode since it increases or reduces the travel the third point must make in order to change from the neutral phase to the discharge phase.

Maximum sensitivity will be obtained with the lever (4) in the (+) position while the minimum sensitivity is obtained in the (-) position.



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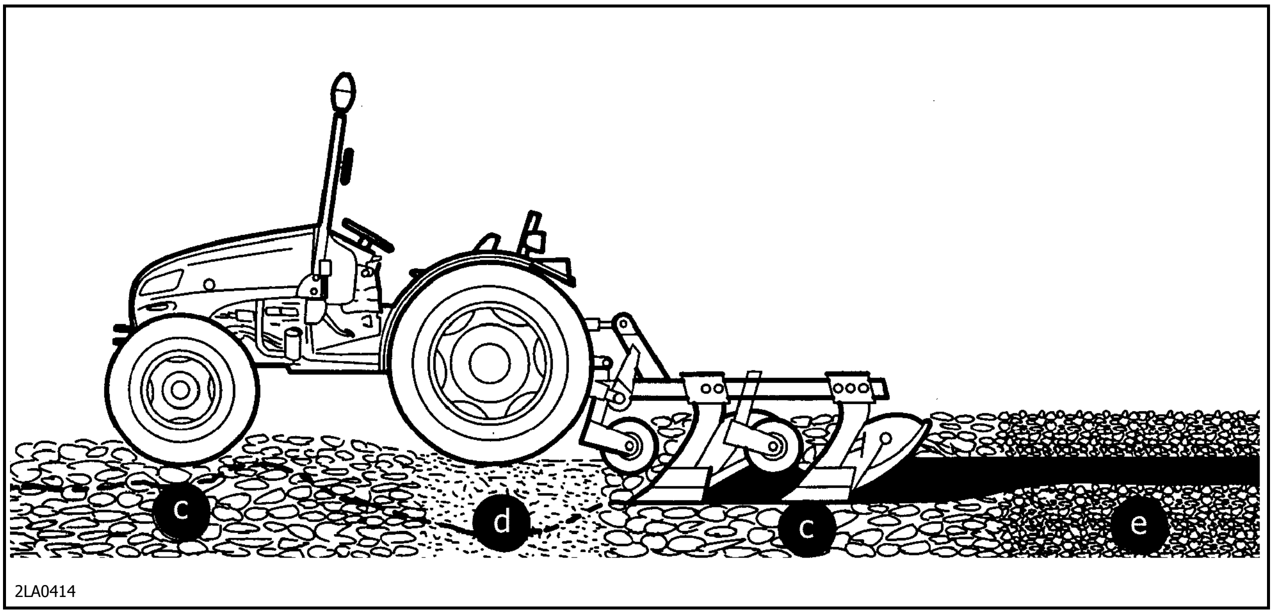
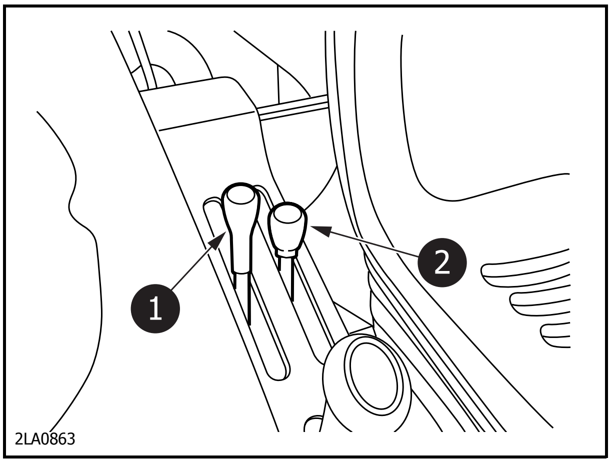


8

Mixed position and draft control

When work is carried out in the draft control mode on irregular soil, there may be excessive variations to the work depth which are unacceptable for cultivation on that type of ground.
In these conditions, the mixed position-draft control mode should be used.
To work in this mode, dig the implement into the soil and establish the required work depth as described for the draft control mode. Once this depth has been reached, lower the draft control lever (1) and gradually move the position control lever (2) downwards in order to increase the degree of position control. The power lift operates in the draft control mode but meanwhile prevents the implement from digging excessively into softer soil and producing an uneven job.
When the power lift is preset for the mixed position and draft control mode (intermix), the maximum and minimum depths at which the implement works are limited in relation to the mean value (see zone d = sandy soil; zone e = compact soil) since knob movement towards the position control setting reduces the sensitivity of the draft control action and introduces part of position control.
The positions to which the lever can be set are as many as can be obtained in the space that separates the two ends and its vicinity to one end or the other leads to a greater influence being excercised by the position or draft control functions.
During work, the operator must find the best position for the selector lever in order to obtain the best compromise between draft variation and depth.



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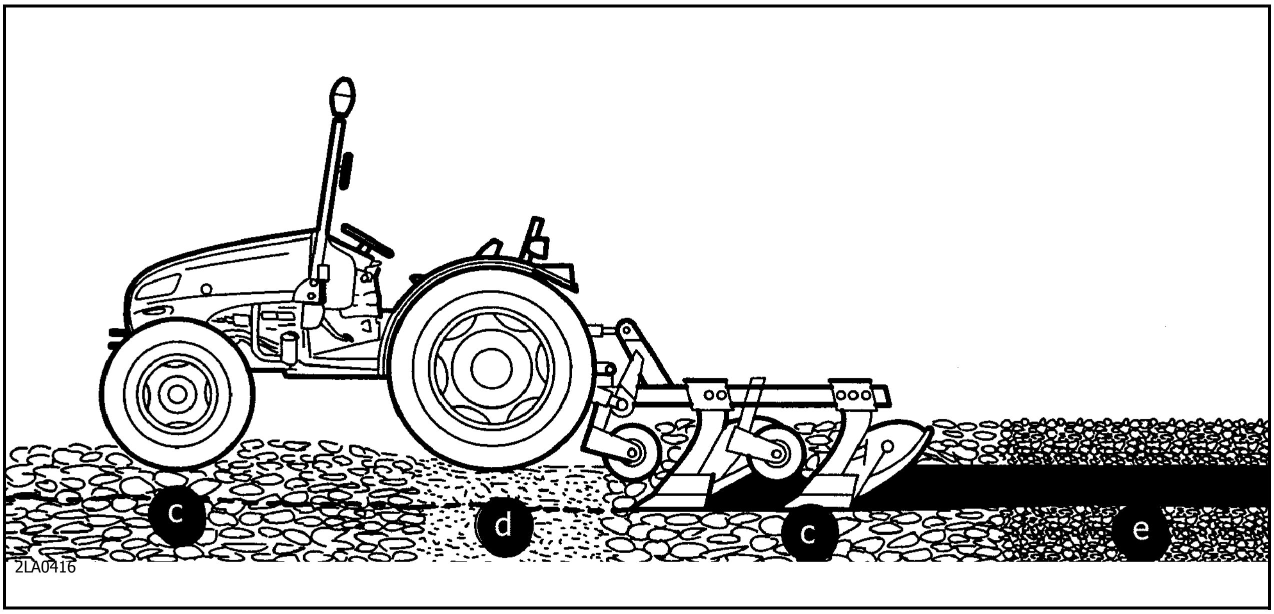


10

Floating position

To work in the float mode, move both the levers fully down (1 and 2, fig. 9).

The floating position allows the lift links to swing freely.

The floating position is therefore used for all implements that must simply rest on the soil and follow the contours of the ground, or for semi-mounted implements that have specific components with which they rest on the ground.

DESCRIPTION OF THE OPERATING MODE OF THE HYDRAULIC POWER LIFT'S VALVE SYSTEM

Three phases always occur during power lift operation, regardless of whether it is used in the position control or draft control mode or with contemporaneous draft and position control (Intermix):

Valve system in the neutral phase

Valve system in the lifting phase

Valve system in the discharge phase

To make the descriptions clearer, these three phases will therefore be illustrated individually. However, remember that the three phases take place without any specific order when the power lift operates, particularly in the draft control and Intermix modes.

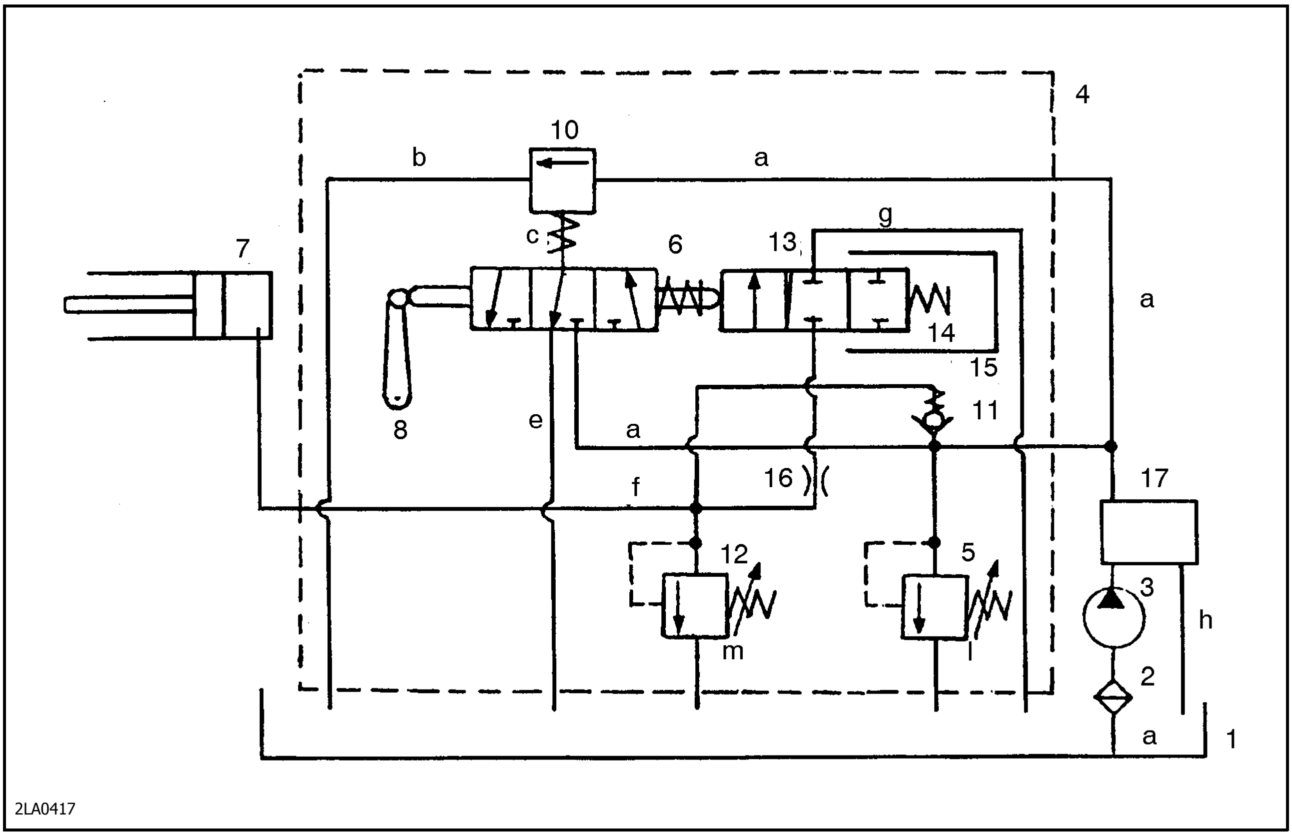
Neutral phase

As soon as the engine is started, the pump (3) draws oil from the tank (1) through the filter (2) and sends it through duct (a) where it encounters the valve stem (6) in the central position of its travel, which shuts off the delivery to the control unit (c).

Meanwhile, the oil passes through duct (a) formed inside the valve system, and reaches the check valve (11) that supplies the ram (7). This remains closed as oil from the pump cannot reach a sufficiently high pressure to open it owing to the lesser opening resistance of the servo valve (10). This latter is able to open thanks to the open piloting hole (c) which allows the oil in the piloting chamber (d) to discharge into the housing through ducts (c) and (e). This allows the oil from the pump to discharge into the housing through duct (b).

Note that ducts (a) and (f) in the valve system are races made around the body (4) so that the oil can reach the various valves. The oil in the ram (7) and duct (f) is blocked by the discharge valve (13) which is shut, thus the circuit is tight.

The cylinder safety valve (12) protects the circuit between the ram (7) and the discharge valve (13), opening and discharging the pressure peaks created when the tractor jolts or when the implement strikes against the ground.



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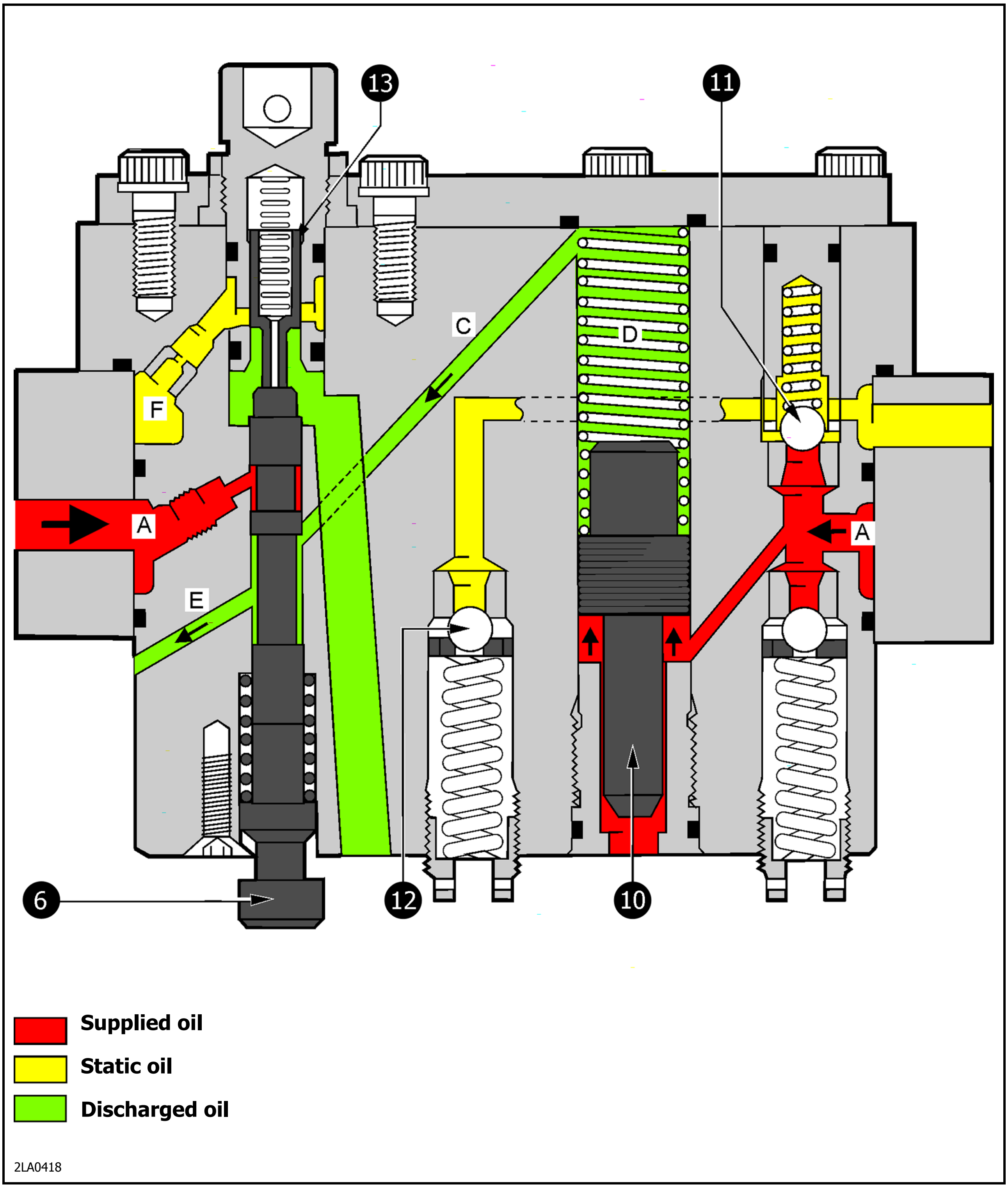
In figure 12, different colours are used to show the oil flows in the different operating conditions, in the neutral phase.



12

Lifting phase

When the operator uses the position control lever to raise the implement, or when in draft control mode, the implement transmits a signal indicating that it has encountered greater resistance in the soil, lever (8) moves away from the valve stem (6). This, influenced by its spring (9), follows lever movement towards the left, thus setting to the lifting phase.

The discharge valve (13) remains closed during this movement.

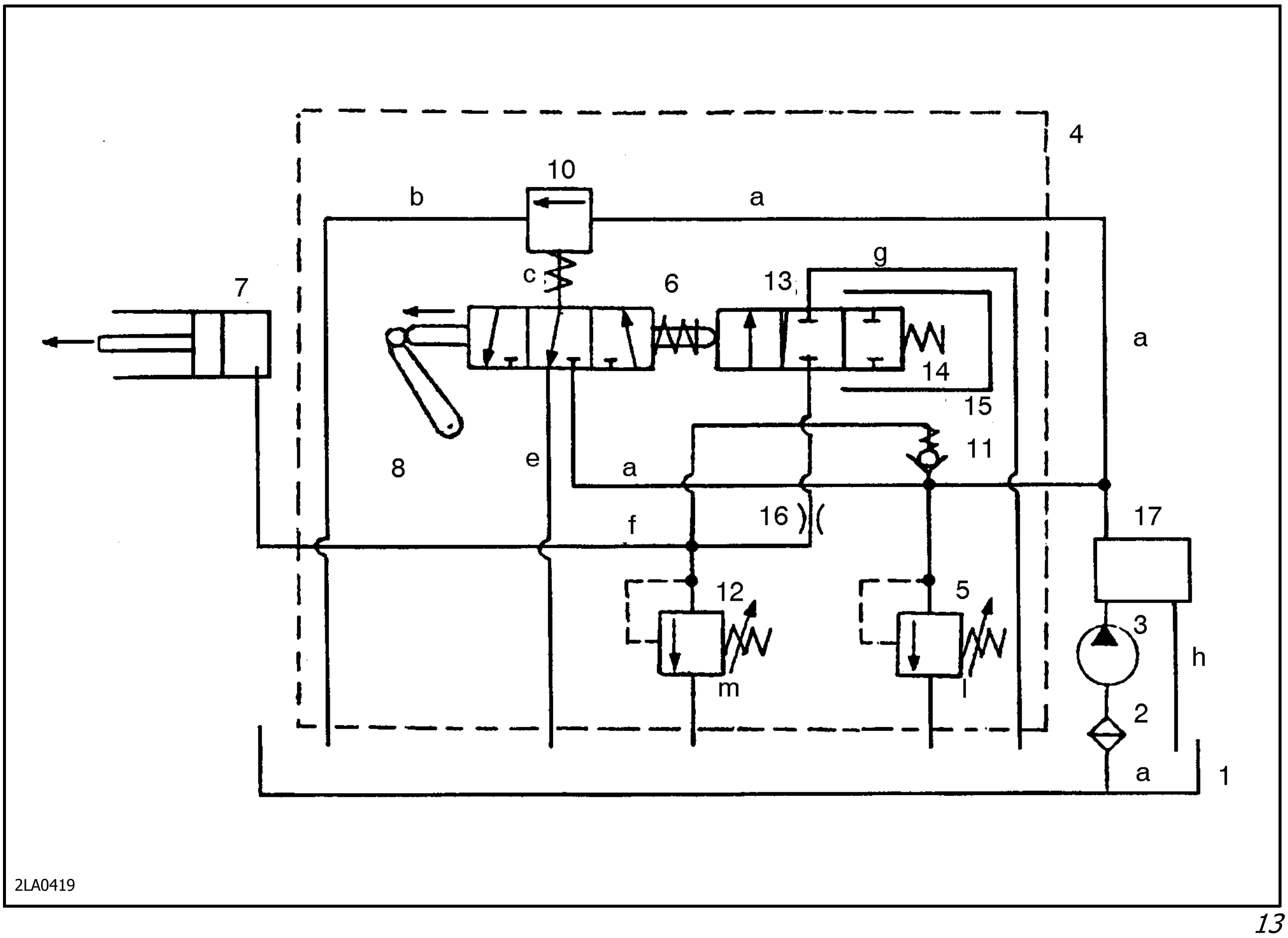
Oil on the delivery from duct (a), can now reach the servo valve (10), the valve stem (6) and duct (c). Since the surface of this side of the servo valve is larger than the one on the side of the duct (b), the servo valve closes also thanks to the force exercised by the spring.

As the servo valve begins to close, preventing the oil from flowing into the tank, the pressure begins to rise until its value allows the oil from the pump to open the check valve (1) and flow towards the ram (7).

Having reached the required height, the lever (8) moves the valve to the neutral position.

The rear part of the servo valve (10) is set to the discharge phase through ducts (c) and (e). Thus oil on the delivery opens the servo valve again and discharges into the transmission housing.

The pressure in the supply duct consequently drops and the check valve (11) closes owing to the spring and the higher pressure in the user circuit, thus stopping the links from lifting.



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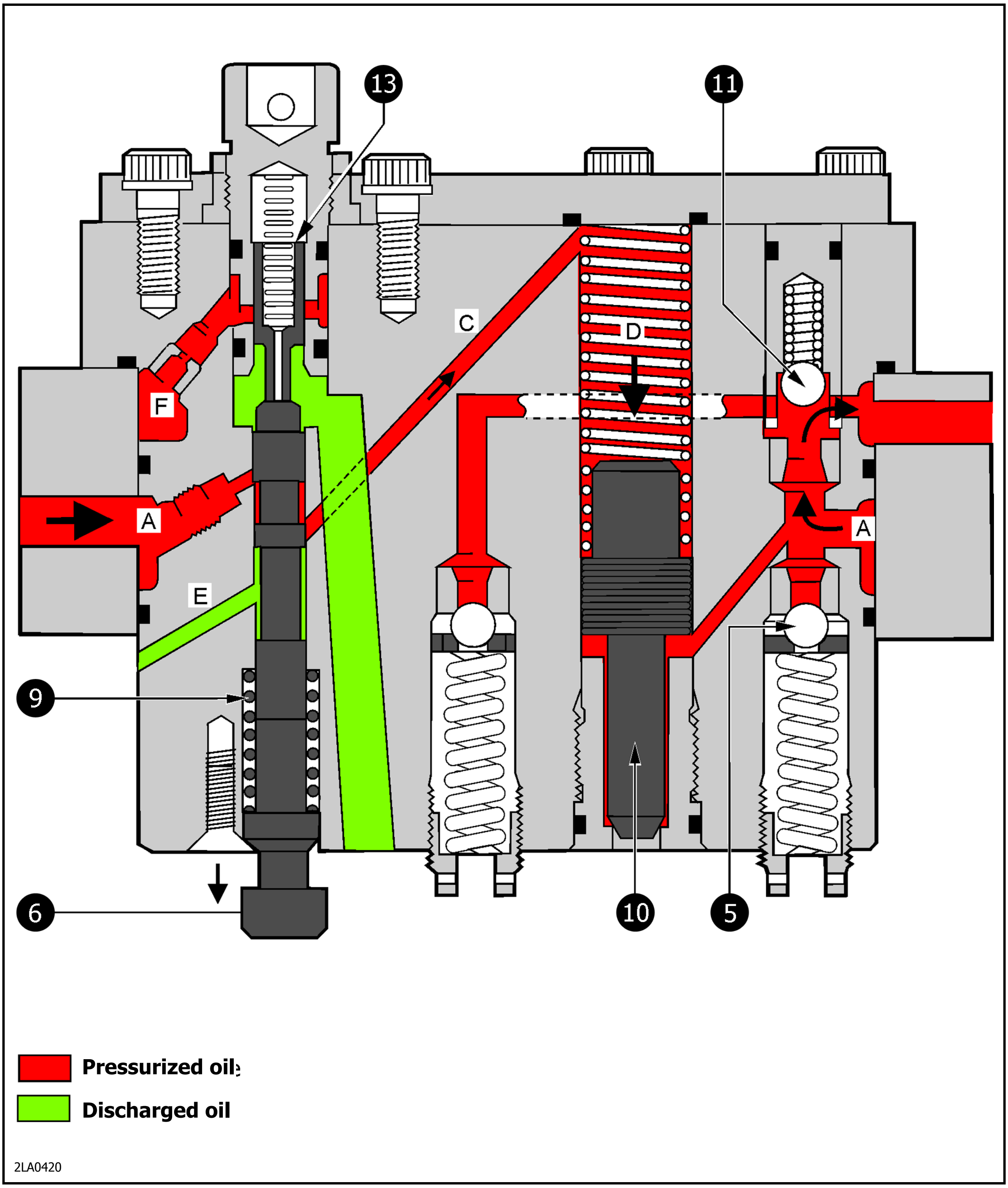
In figure 14, different colours are used to show the oil flows in the different operating conditions, in the lifting phase.



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Discharge phase

When the links must lower, lever (8) pushes the valve stem (6) fully into the body of the valve system. This manoeuvre also involves the discharge valve (13) which is moved and opened by the mechanical action of the valve system itself.

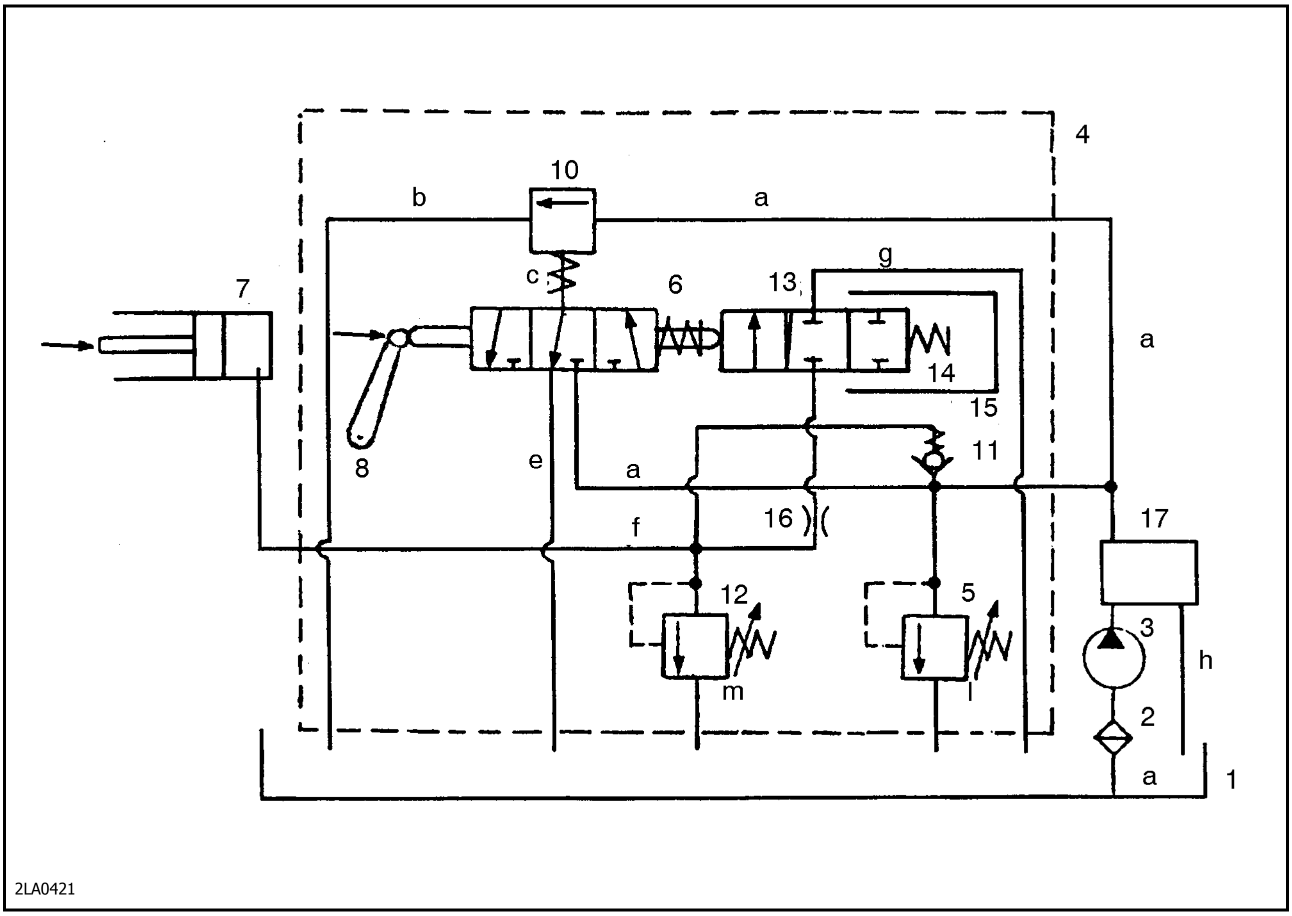
Valve (13) opening, sets ram (7) in communication with the outlet, through duct (g).

Note that since the discharge valve (13) has a sliding cylinder, there will be no valve surging, the advantage being that the links will lower in a regular way. Moreover, throttle (16) limits the lowering speed.

Once the required height has been reached, the control lever (8) moves back and the valve stem (6) is pushed back to the neutral position by its spring (9). Affected by spring (14), the discharge valve (13) also returns to its hold position, gradually shutting off the oil flow towards the outlet and bringing the user circuit to the tight status.

As the links lower, the valve stem (6) keeps the servo valve (10) released thanks to duct (c) which is discharging via duct (e). The oil delivered by the pump thus discharges through the actual servo valve and duct (b).

The adjuster device (15) allows the discharge valve (13) to move nearer or further from the valve stem (6) so as to increase or decrease the sensitivity of the power lift.



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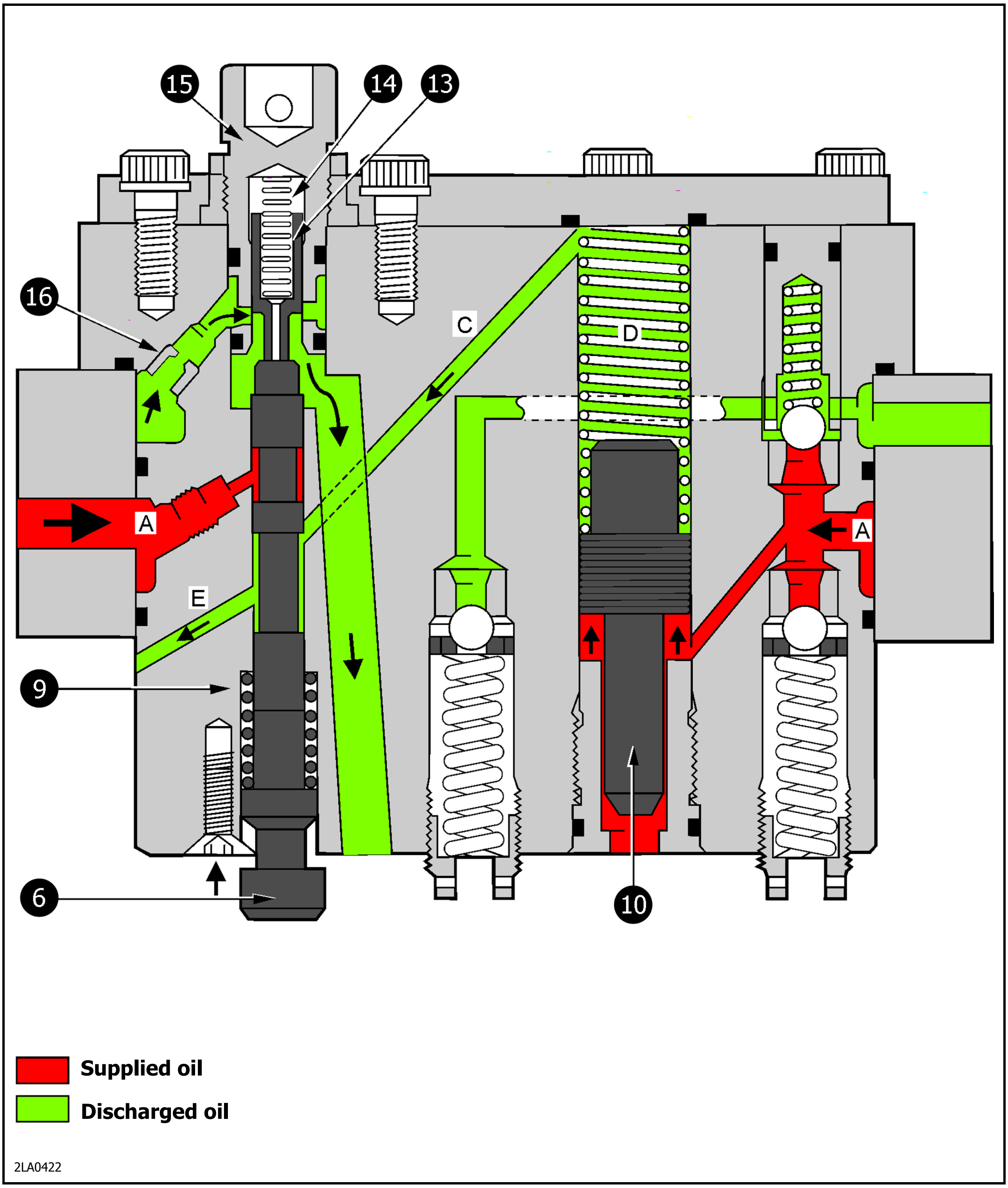
In figure 16, different colours are used to show the oil flows in the different operating conditions, in the discharging phase.



16

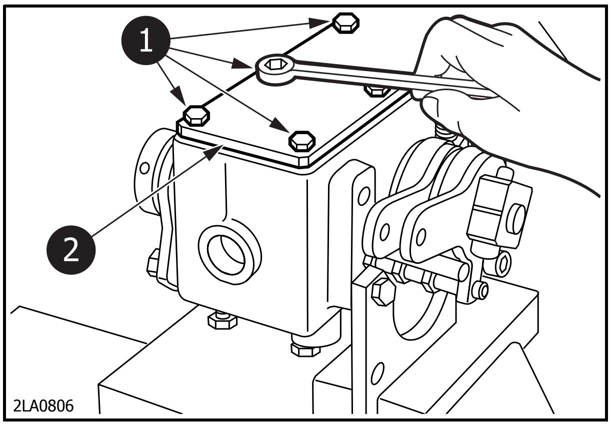
POWER LIFT'S VALVE SYSTEM - OVERHAUL

Demounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

1. Split the power lift's valve system.
2. Unscrew the bolts (1), remove the cover (2).



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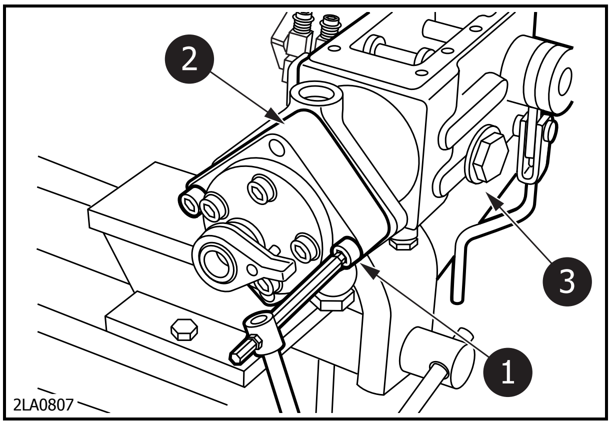
3. Unscrew the fixing screws (1) of the valve system (2) and remove this from its housing.



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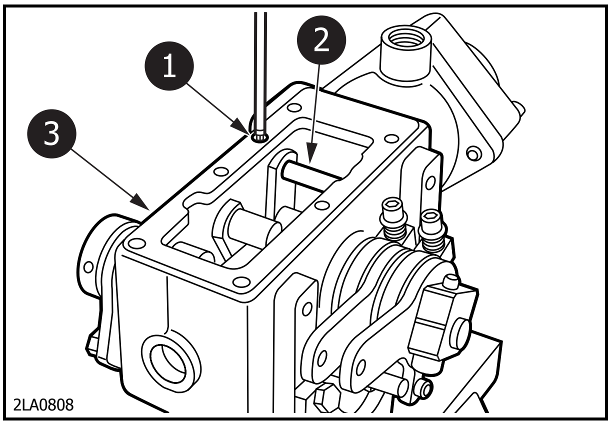
4. Lock the linkage housing of the valve system (3) in a vice and remove the Allen screw (1) that fixes the valve system's pin shaft (2).



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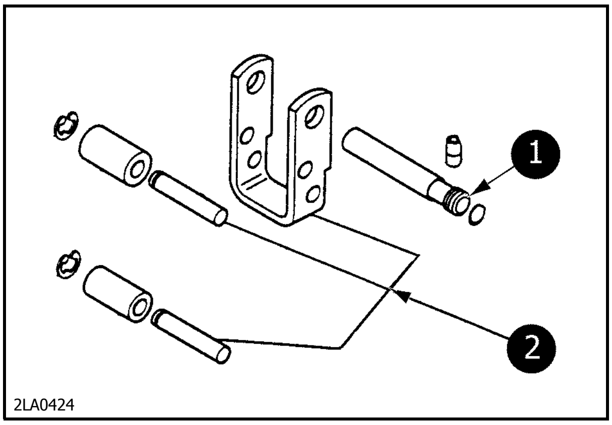
5. Release the shaft (1), remove it from the linkage housing and take out the valve system's pin control lever (2).



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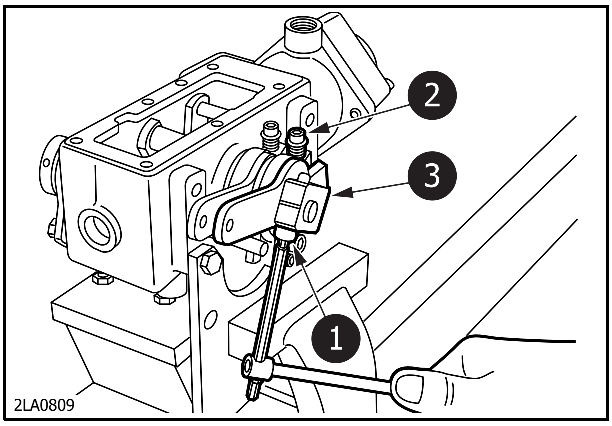
6. Release the Allen screw (1), loosen screw (2) and remove the lever (3).



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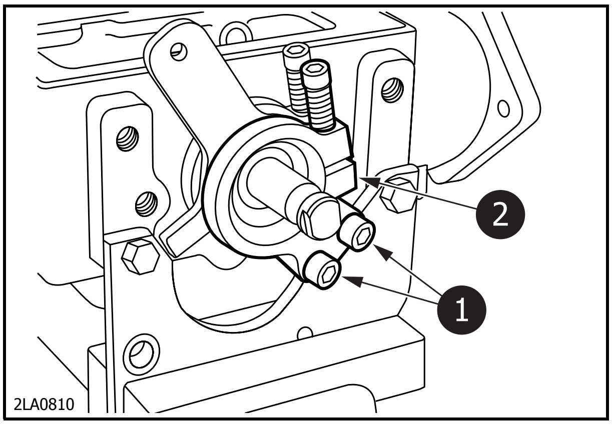
7. Unscrew the screws (1) and remove friction ring support (2).



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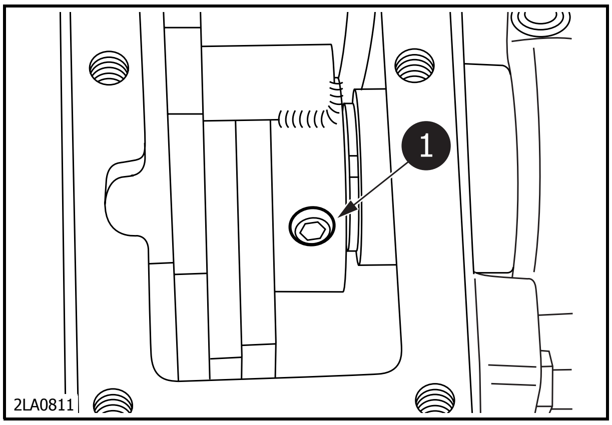
8. Unscrew the retainer plug (1) of the eccentric shaft.



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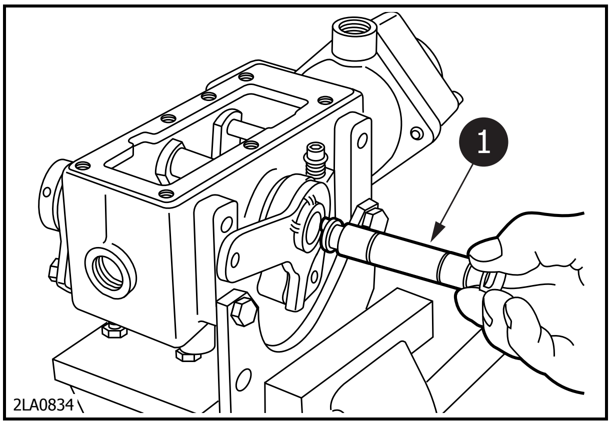
9. Remove the eccentric shaft (1).



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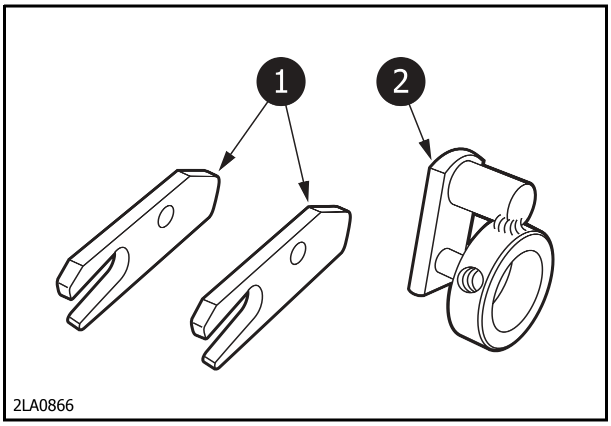
10. Remove the plates (1) and the eccentric ring (2).



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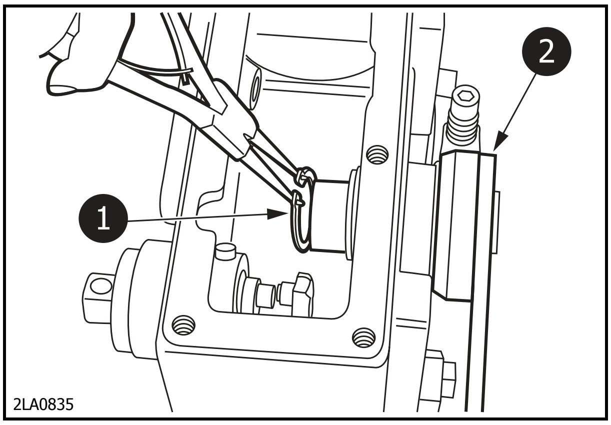
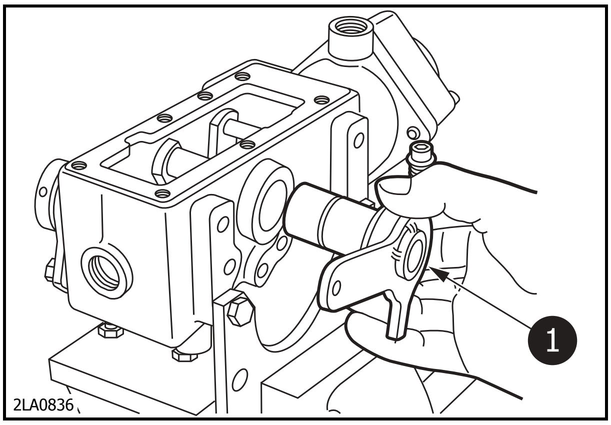
11. Remove the spring ring (1) that holds the lever (2).



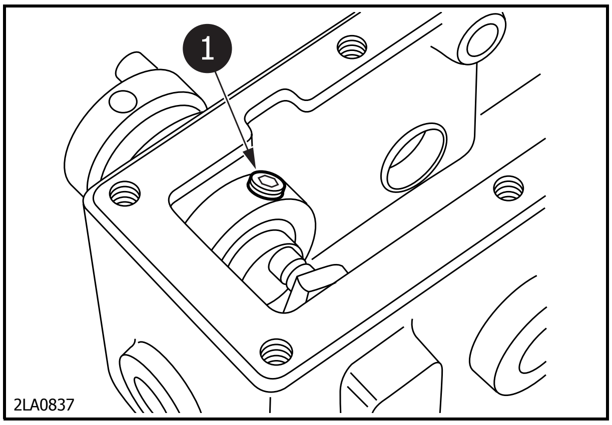
26

12. Remove the lever (1) complete with the friction ring support.



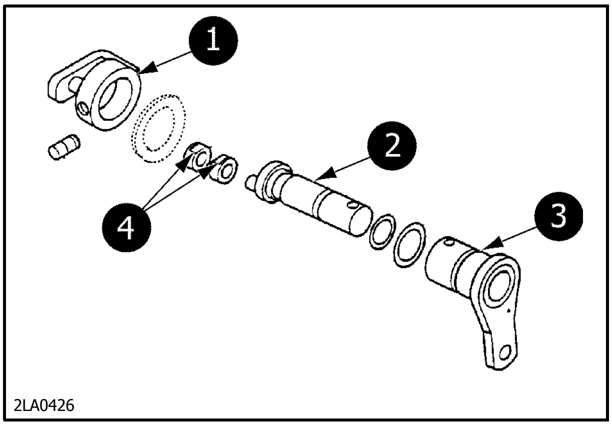
27

13. Remove the Allen screw (1) that fixes the shafts that control the external linkages.



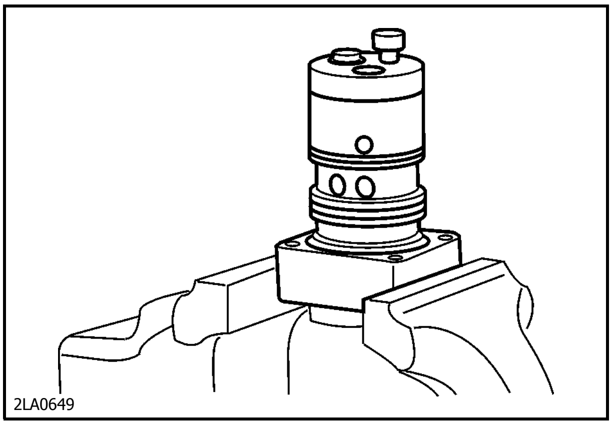
28

14. Remove the screw (6, fig. 24), the external lever (5, fig. 24) and then, in the following order.
- the lever (3);
- the shaft (2);
- the spacer rollers (4);
- the inner eccentric ring (1).



29

15. Hold the valve system firmly in a vice. Take all the necessary precautions to prevent it from being damaged.



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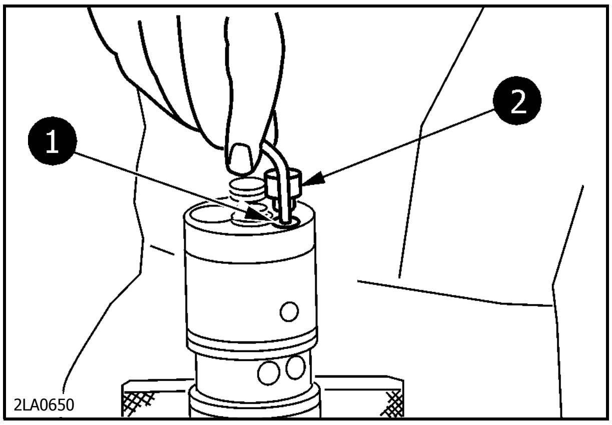
16. Unscrew the screw (1) that retains the valve system pin (2).



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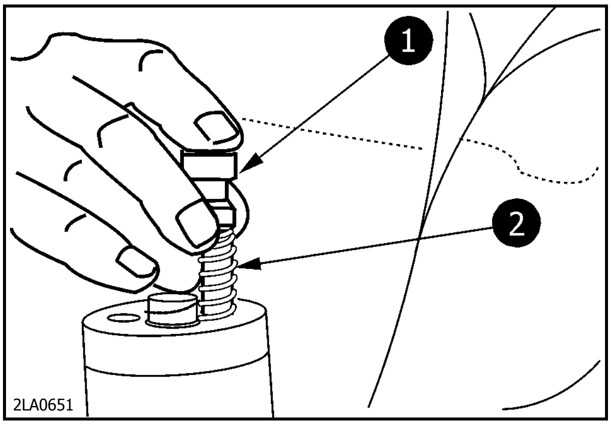
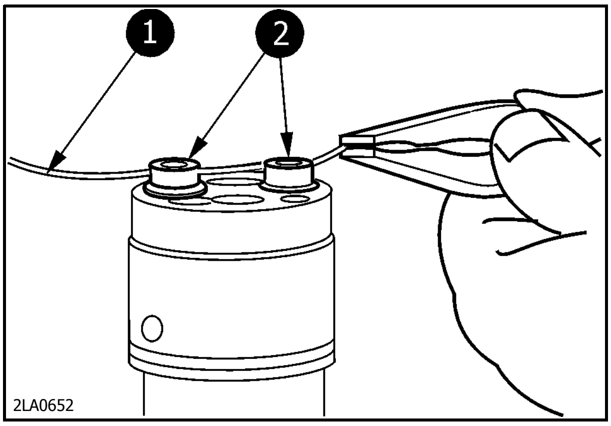
17. Remove the pin (1) from the valve system and recover the spring (2).



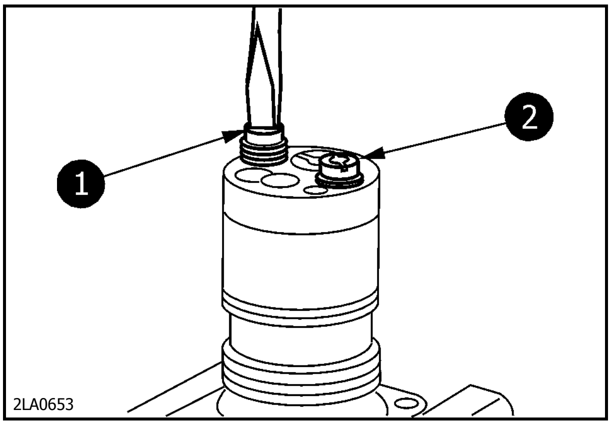
32

18. Remove the safety wire (1) from the over-pressure valves (2) and the cylinder safety device.



33

19. Demount the over-pressure valve (1) and the cylinder safety valve (2).



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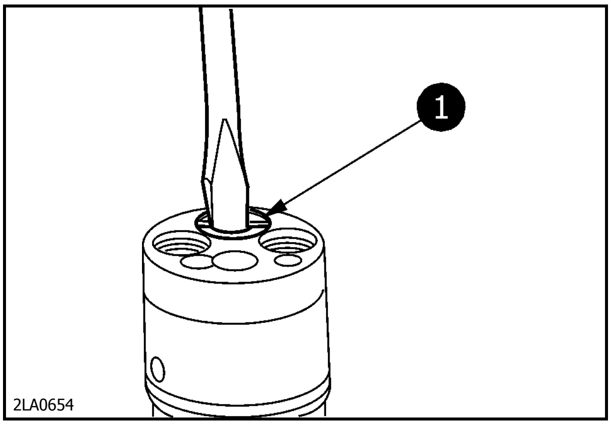
20. Demount the pilot valve (1).



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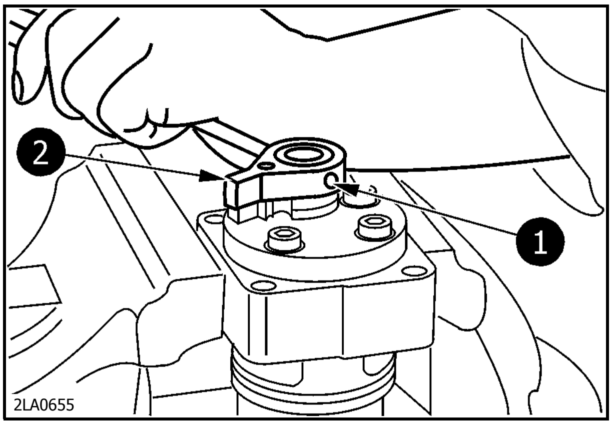
21. Open the vice, turn the valve system through 180° and shut the vice again. Take all the necessary precautions to prevent the components from being damaged.
Use a special pin driver to remove the spring pin (1) and sensitivity adjuster lever (2).



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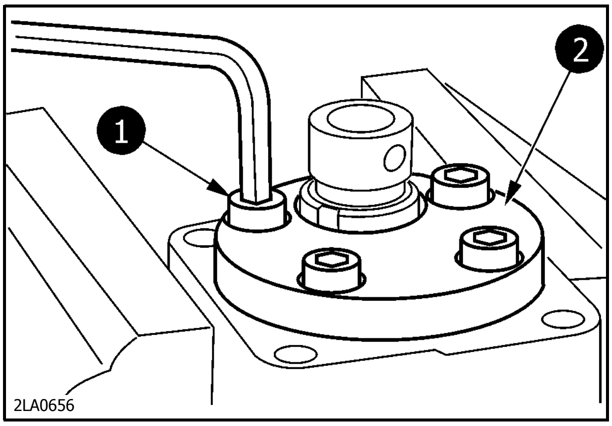
22. Unscrew the screws (1) that fix the upper cover (2) and remove this.



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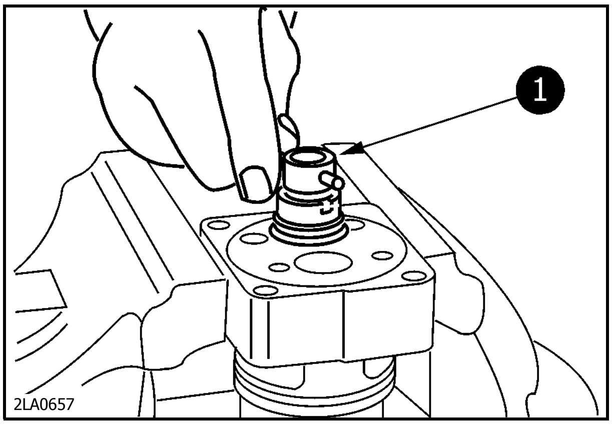
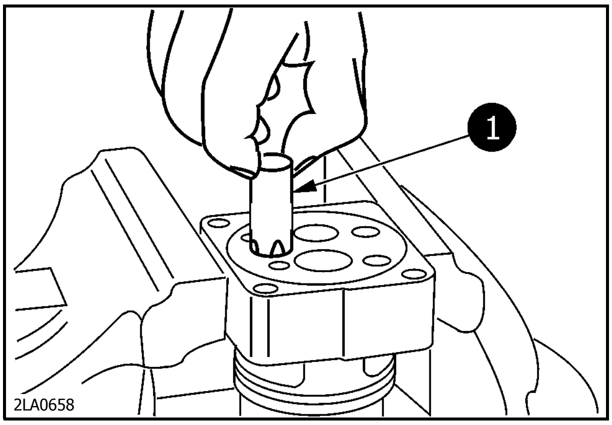
23. Take out the discharge valve (1) using the relative tool.



38

24. Take out the non-return valve (1).



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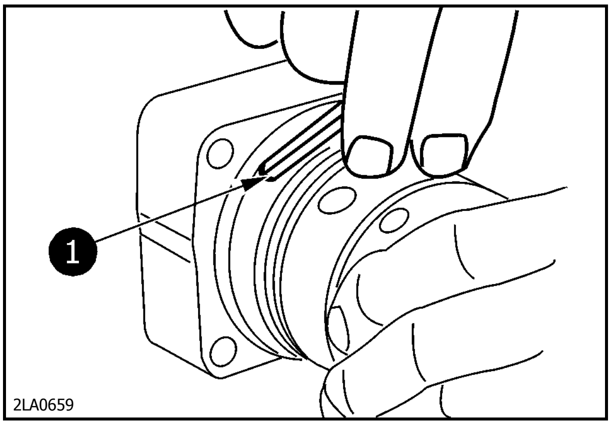
25. Demount the calibrated nozzle (1).



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Assembly

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Comply with the following recommendations when remounting the power lift's valve system:

- Comply with the illustrations and descriptions given for the demounting phase in order to position the various parts.
- Mount the calibrated nozzle.
- Insert the non-return valve.
- Insert the discharge valve.
- Position and fix the upper cover of the valve system.
- Mount the sensitivity adjuster lever and fix it in place with the relative spring pin.
- Mount the pilot valve.
- Mount the cylinder safety valve.
- Mount the over-pressure valve.
- Adjust the safety valve and pressure.
- Lock the positions of the valves with the safety wire.
- Insert the pin with its relative spring.
- Lock the valve pin with the relative check screw.
- Remount the two rear shafts (including the spacer rollers).
- Mount the inner eccentric ring (rocker arm).
- Mount the other external lever (take care when positioning as both levers must point towards the valve system).

- Mount the external spring pin that fixes the lever.
- Mount the internal Allen screw that fixes the shafts that control the external linkages.
- Mount the external draft transmission lever.
- Mount the fork, the front eccentric ring and the other connection fork.
- Fit the eccentric shaft into the fork hole.
- Tighten the Allen screw that fixes the draft transmission lever.
- Mount the friction ring support.
- Mount the position control lever.
- Align the internal forks (with the indents on the horizontal shaft and the backward stroke levers).
- Mount the fixing screw of the position control lever.
- Mount the control linkage of the valve pin and the relative Allen screw.
- Protect the surface in contact with the upper cover with silicone and fit the cover itself on to the linkage housing.
- Position the valve system in its housing and fix it in place with the relative screws.
- Shut the valve system housing with its cover.
- Now fit the valve system back on to the power lift.

VALVE SYSTEM OF THE HYDRAULIC POWER LIFT – HYDRAULIC TESTS

During these tests, the valve system must be made to operate in the various conditions in which it may be called upon to work when the power lift is operating on the tractor.

These tests allow the valves to be calibrated, to make sure that there are no leaks and to establish beforehand whether the assembly operates within the limits for which it was designed and built.

The following tests must be carried out:

Check for leaks from the discharge valve

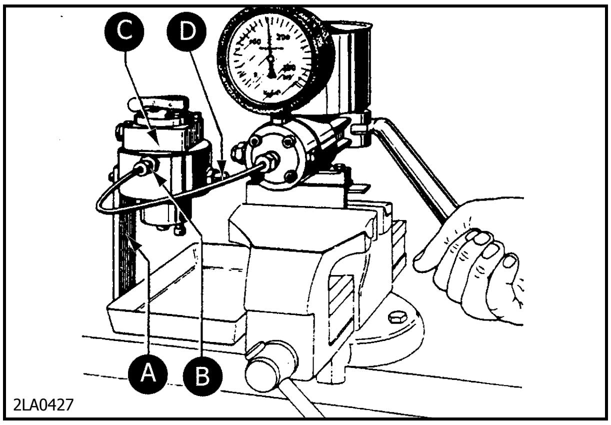
Inspection and adjustment of the safety valve

Check for leaks from the non-return valve on the user duct

Inspection and calibration of the over-pressure valve

Check for leaks from the discharge valve

1. Place the valve system (C) in tool **001 IDR MIS** (A) and position it so that the supply holes are not shut off.
2. Connect the high pressure pump hose **002 IDR MIS** to the upper union (B) of the tool (lifting ram duct).
3. Position a suitable bolt between the base of the tool **001 IDR MIS** and the valve stem (7, fig. 42) then unscrew the bolt and lift the stem until its end is about 4 mm away from the lower surface of the body of the valve system.
4. Operate the pump and make sure that the discharge valve (3, fig. 42) discharges the oil from the duct (G, fig. 42). If this fails to occur, turn the sensitivity lever clockwise until the valve opens.
5. Continue to operate the pump and begin to slowly turn the sensitivity lever in the anti-clockwise direction to start closing the valve.
6. Stop this operation as soon as oil stops flowing from duct (G, fig. 42) and the pressure gauge shows that the pressure is increasing (position 1).



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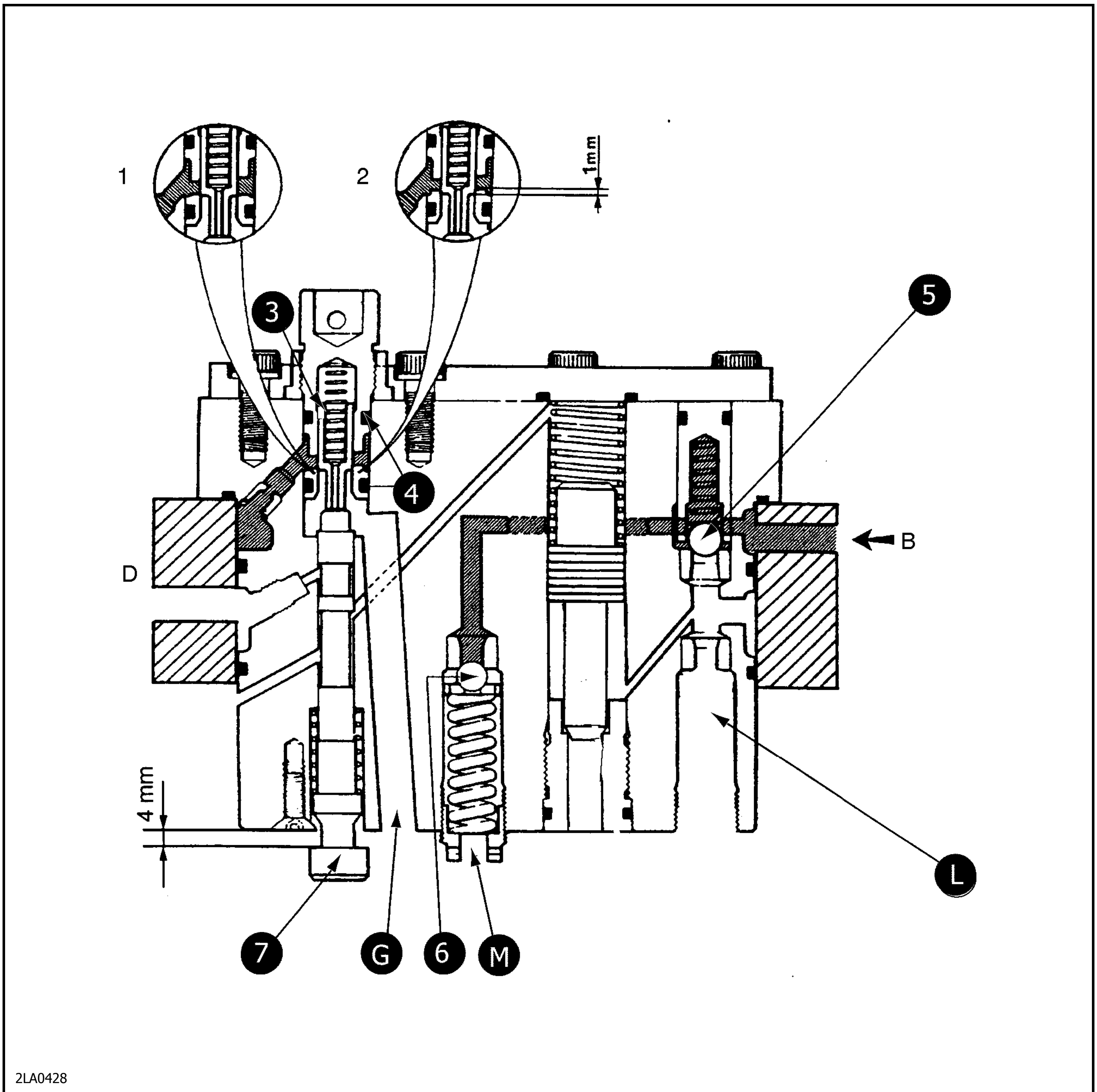
7. Turn the lever again, about 280° in the anti-clockwise direction. This ensures a 1 mm valve coverage in relation to the discharge gaps of its seat (position 2, fig. 42). Now operate the pump until the pressure reaches the value of 150 bar.

At this stage, the pressure should start to drop very slowly. This this fails to occur, it denotes excessive leaking between the valve (3, fig. 42) and its seat or between the retention rings (4, fig. 42) and the body of the valve system.
The maximum leak tolerated at a pressure of 150 bar and at a temperature of 25 - 30 °C is 3 cm^3, within 3 minutes.
If the value measured is higher, demount the valve and replace the retention rings (4, fig. 42), then repeat the test. Replace the discharge valve (3, fig. 42) and its seat if the fault persists.

Checking and adjusting the cylinder safety valve

1. Keep the pump connected to the same tool union and operate it until the cylinder safety valve (6) opens.
   It must open at the value of 185 - 190 bar.
   If this fails to occur, adjust the valve by means of the retention plug of the spring.
   Tighten the plug to increase the setting value, slacken it off to decrease the value.
2. Once the valve has been adjusted, place a graduated test tube under the valve system and keep the pressure in the circuit at 150 bar. The maximum leak tolerated in two minutes at an ambient temperature of 25 - 30 °C must not exceed 10 cc.
3. If the leaks exceed the tolerated value, check to find out which component is leaking then, having eliminated the possibility of this being the discharge valve which has already been checked, make sure that the cylinder safety valve (6, fig. 42) is tight by checking to see that no oil flows from duct (M).
   If oil is seen, its housing must be milled with an adequate tool in order to re-create the sharp internal edge.



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Non-return valve test

Leaking can also be caused by the non-return valve (5, fig. 42). Proceed in the following way to locate the entity of the leak:

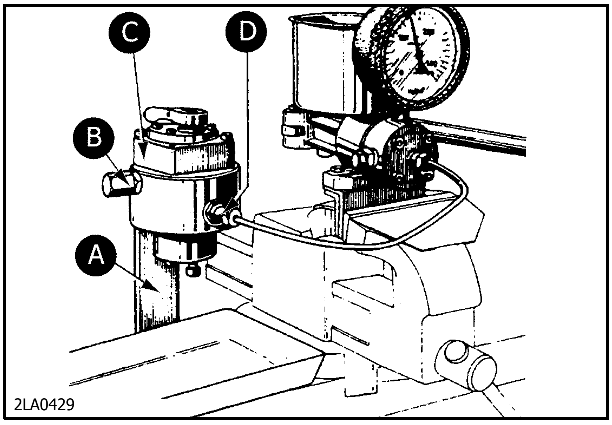
1. Remove the calibration valve which is in direct communication with the duct that delivers oil to the valve: this allows the oil to flow straight through duct (L, fig. 42).
2. If oil flows through duct (L, fig. 42), mill its housing with an adequate tool in order to re-create the sharp edge on its housing, in compliance with the following recommendations.
   - Use an upright drill to mill housings in order to ensure that the mill operates in a perfectly perpendicular way.
   - The tool must turn between 100-200 RPM at most.
3. Check the upper and intermediate retention rings of the valve system if the leaks persist.

> Do not attempt to re-create the seats by tapping on the balls as this would only enlarge them.

Over-pressure valve setting test

This test must also be carried out with tool **001 IDR MIS** . Proceed as follows:

1. Move the pump delivery hose to the lower union (D) and screw the closing plug on to union (B) used for the "Test for leaks from the discharge valve" (Fig. 41).
2. Fit the previously removed over-pressure valve (9, fig. 44) on the valve system.
3. Start the pump and check the pressure gauge to see the pressure value at which the over-pressure valve (9, fig. 44) opens: The exact value is 185 - 190 bar.
   If necessary, adjust the valve by means of the spring retention plug.
4. Once the valve has been adjusted, maintain a pressure of 150 bar in the circuit and, after having set a graduated test tube in position, make sure that the servo valve (8, fig. 44) leaks no more than 100 cc. within the space of 2 minutes.
   The part must be replaced if this limit is exceeded.



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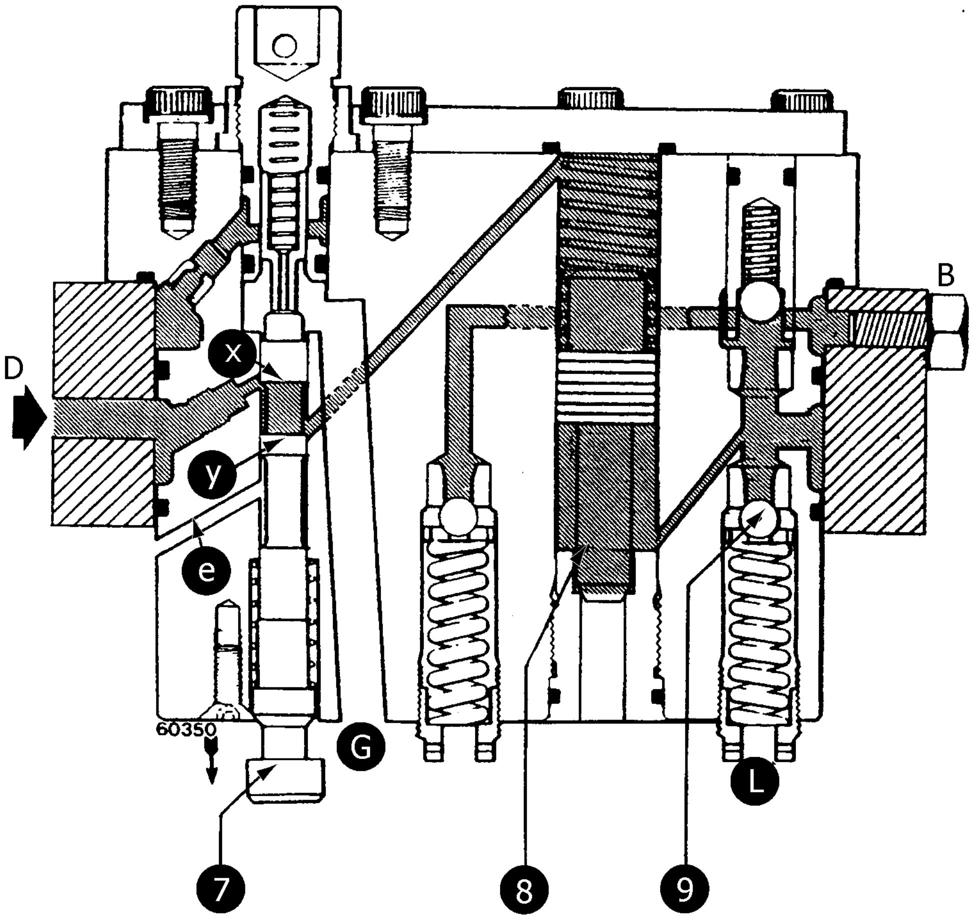
5. Make sure that no oil leaks from the duct (L) of the calibration valve.
If necessary, mill the valve seat as described in the previous section.



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If oil leaks from duct (G), this is due to the play between the upper part (X) of the stem (7) and the body of the valve system (it will not be due to the discharge valve as this has already been checked).

Oil leaking from duct (e) is due to the play between the lower part (Y) of the stem and the body of the valve system.

This leak cannot be eliminated, but will not affect the functionality of the system in any way.

However, it must not exceed 100 cc. within 2 minutes.

POWER LIFT – ADJUSTMENTS

The adjustments described below refer to the power lift installed on the tractor.

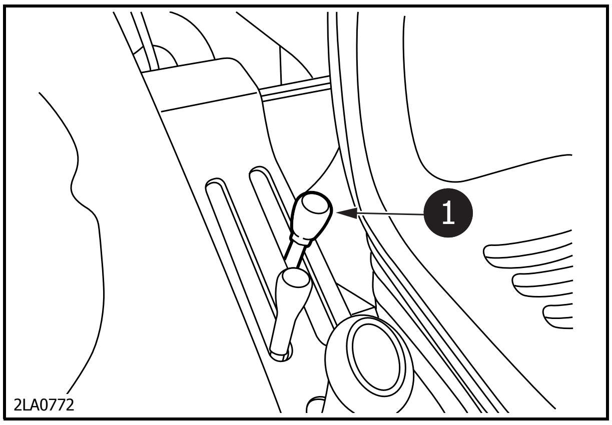
Sensitivity adjustment

Test conditions:

- Apply a weight of at least 100 kg to the power lift links;
- Turn on the engine and accelerate to a rate between 1000 and 1500 RPM;
- The position control and draft control levers must be in the fully forward positions.

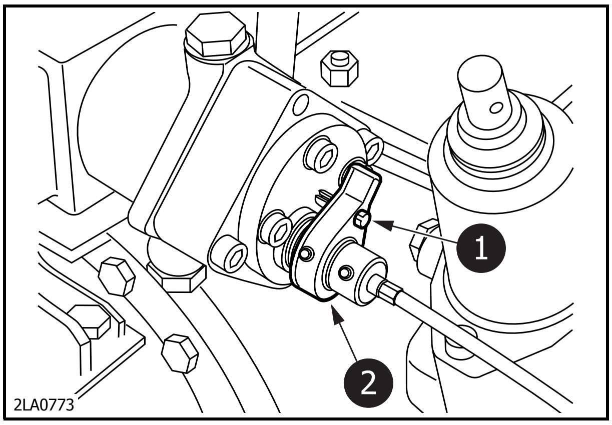
Proceed as follows:

1. Move the position control lever (1) to halfway along its travel.



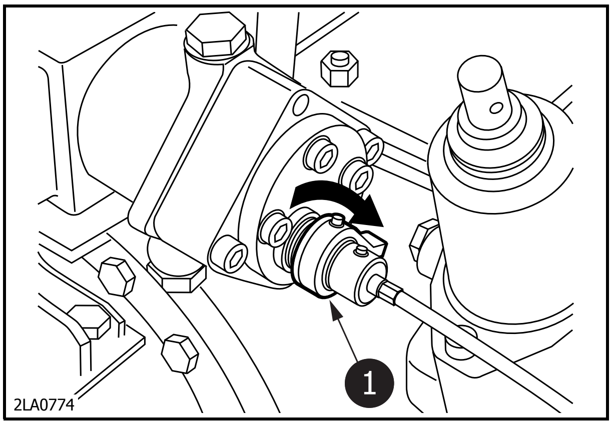
45

2. Partly remove the spring pin (1) that limits the travel of the sensitivity control lever (2).



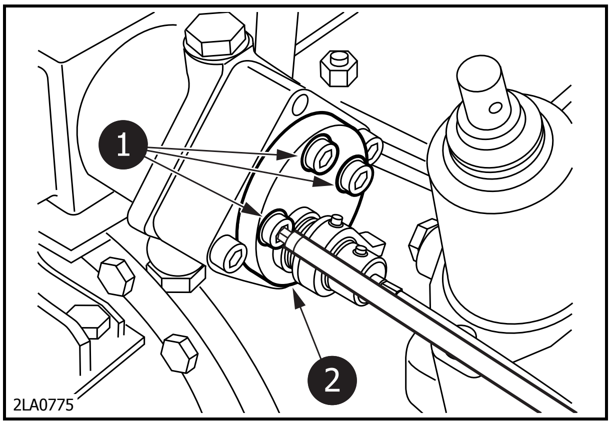
46

3. Turn the sensitivity control lever (1) clockwise to find the point in which the discharge valve starts to open. This will be denoted by the appearance of a rhythmic swing from the lift links.
Proceed in the following way if the valve fails to open after the lever has been fully turned in the clockwise direction:

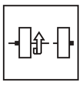


47

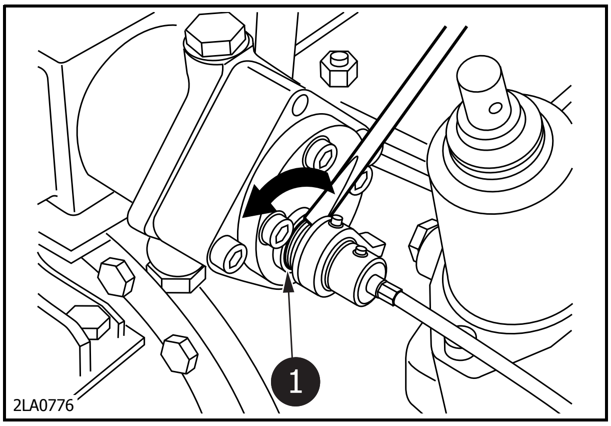
4. Lower the lift links.
Slacken off the four screws (1) that fix the cover (2) of the discharge valve;



48



5. Turn the ring nut (1) anti-clockwise for about half a turn.
Re-tighten the four screws (1, fig. 48) that fix the cover (2, fig. 48);



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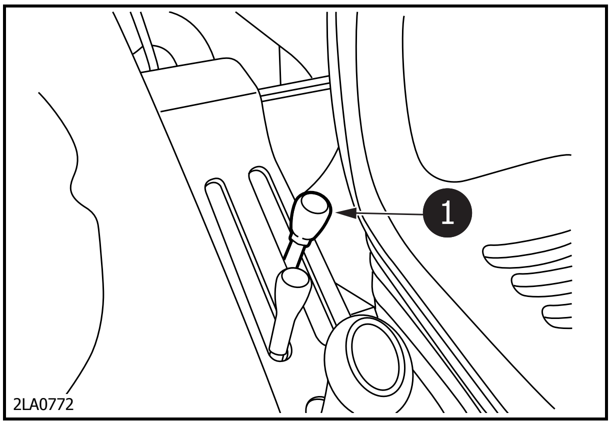
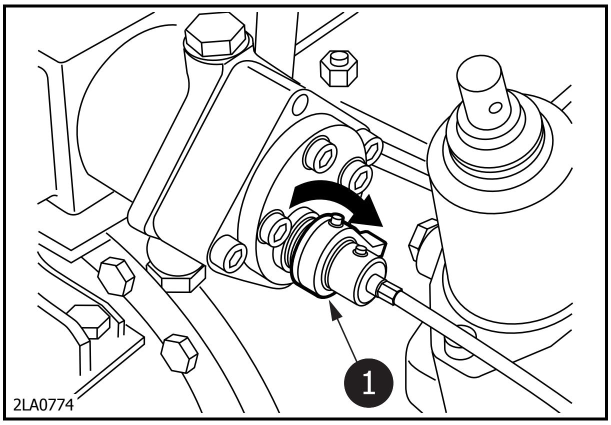
6. Move the lifting control lever (1) beyond half-way on the sector so that the links reach an intermediate position of their travel again;



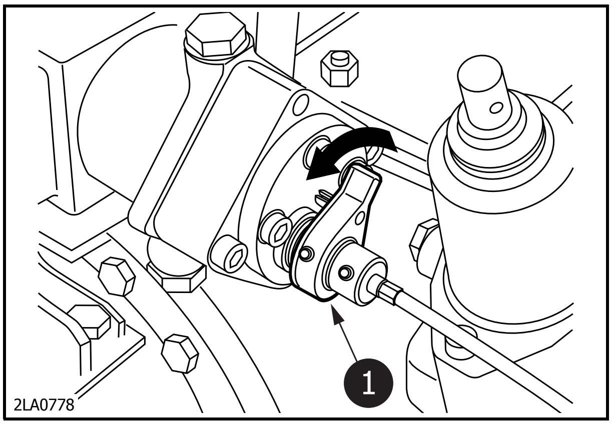
50

7. Turn the sensitivity lever (1) clockwise again until the above mentioned conditions have been obtained.



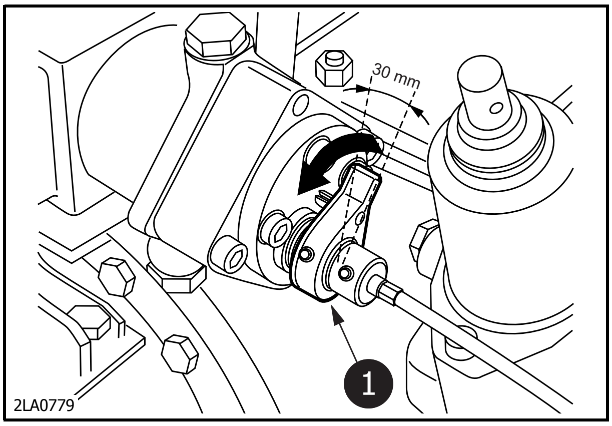
51

8. Now turn the sensitivity lever (1) anti-clockwise until the links stop swinging.
Stop turning the lever, turn off the engine and lower the lift links.



52

9. Turn the lever (1) again about 30 mm in the anti-clockwise direction measured at the ends of the lever itself.



53

10. The position assumed by the lever therefore constitutes the maximum sensitivity point of the valve system.
Since this point can be located with the spring pin on the lever against the lower right countersunk hex screw, after having loosened the four countersunk hex screws, simultaneously turn the lever and ring nut in order to carry the maximum sensitivity point to the required position.

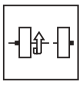
11. Re-tighten the four screws (1, fig. 48) that fix the cover (2, fig. 48) of the discharge valve.

12. Insert the spring pin (1, fig. 45) that limits the travel of the sensitivity control lever (2, fig. 45).

13. Turn off the engine.

14. Remove the weight from the power lift links.

Draft control adjustment

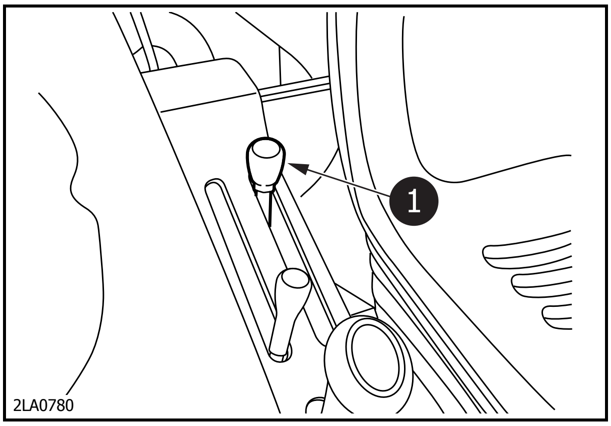


Test conditions:

- Turn on the engine and accelerate to a rate between 1000 and 1500 RPM;
- The position control and draft control levers must be in the fully forward positions.

Proceed as follows:

1. Move the position control lever (1) fully up.



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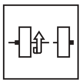
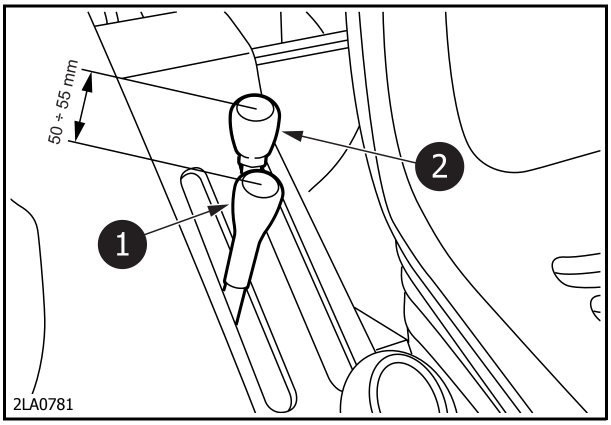
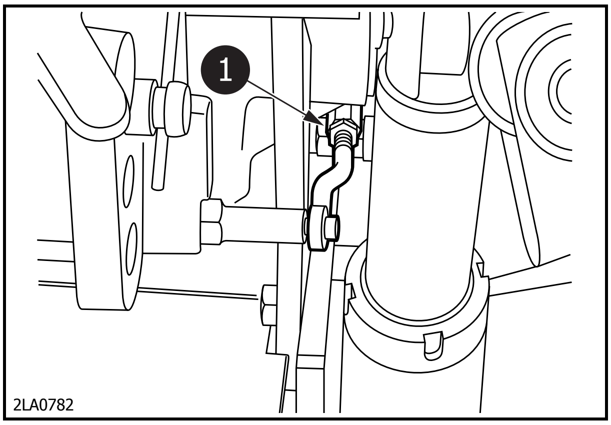


2. Slowly move the draft control lever (1) 50 - 55 mm away from the position control lever (2). Make sure that the links lift.



55

3. Make any adjustments required with the rod (1) if the links fail to lift to the required extent.



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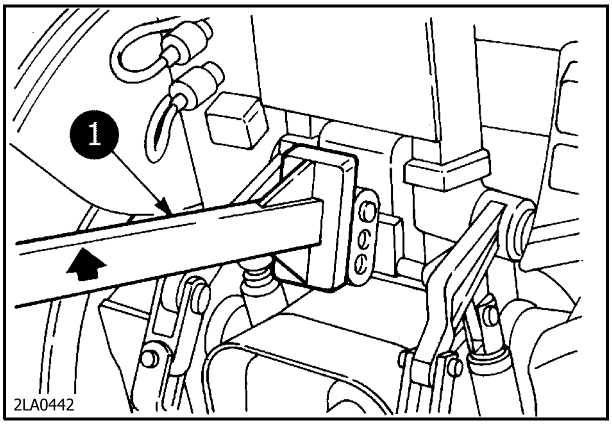
4. Fit tool **003 IDR MIS** (1) on to the swinging support and lift it to annul the the maximum negative draft.



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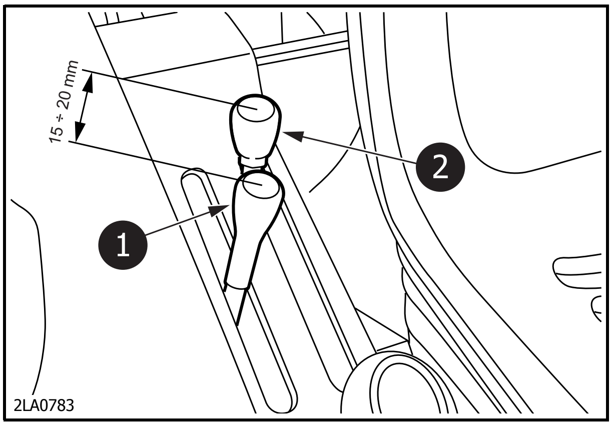
5. Slowly move the draft control lever (1) 15 - 20 mm away from the position control lever (2). Make sure that the links lift.
6. If the measurement indicated in step 19 is not correct, make any adjustments required with the rod (1, fig. 56).
7. Move the draft control lever fully down. Make sure that the links lower.



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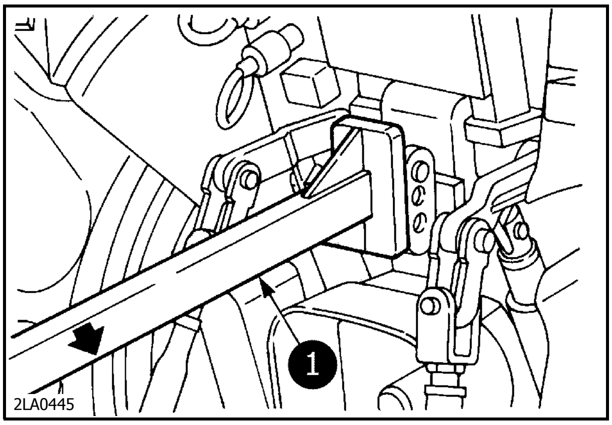
8. Lower tool **003 IDR MIS** (1) so as to annul the maximum positive draft travel. Make sure that the links remain at a standstill in the lowered position.
9. Remove tool **003 IDR MIS** (1).
10. Turn off the engine.



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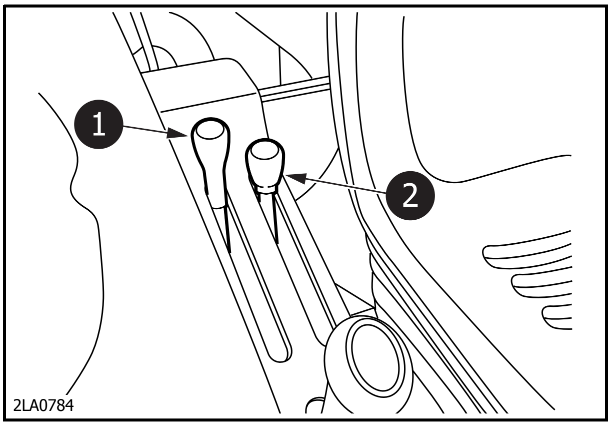
Position control adjustment

Test conditions:

- Turn on the engine and accelerate to a rate between 1000 and 1500 RPM;

Proceed as follows:

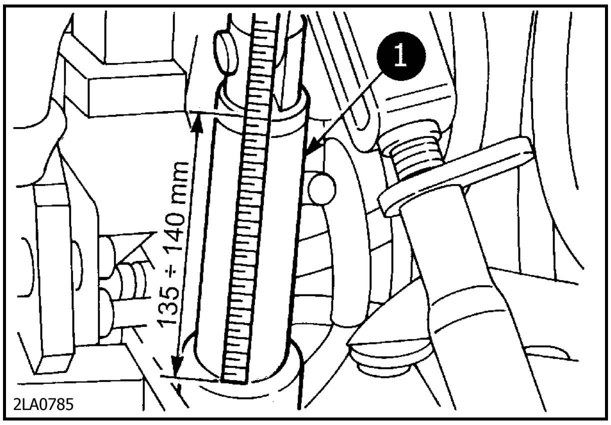
11. The draft control (1) and position control (2) levers must be in the fully back positions.



60

12. Make sure that the cylinder stem projection (1) is 135 - 140 mm from the base of the cylinder.

13. Proceed in the following way to adjust if this measurement is not correct.



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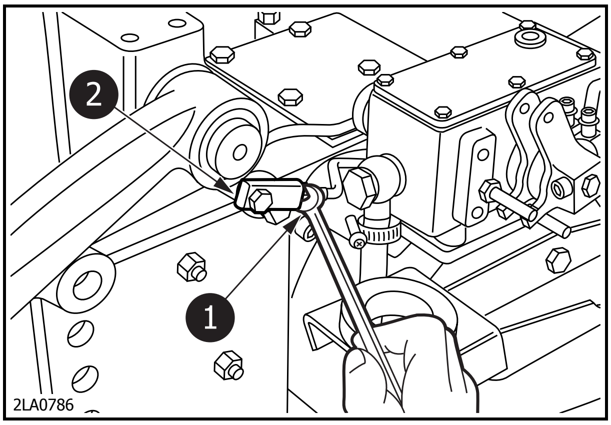
14. Release the rod (2) by means of the check nut (1).



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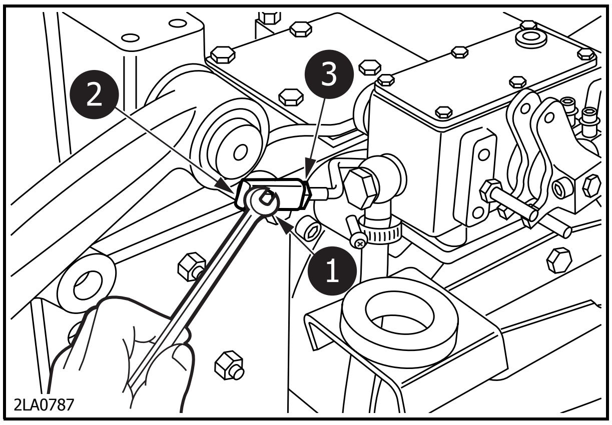
15. Unscrew the screw (1) that locks the adjuster rod (2).

16. Turn the rod until the required adjustment has been made.

17. Fix the rod in position and re-tighten the check nut (3).



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HYDRAULIC POWER LIFT – OPERATING PRESSURE TEST

The operating pressure test must be conducted whenever faults are encountered or when the tractor is generally overhauled.

Remember that if the settings of the governor valves in the circuit are too low, this will reduce the lifting capacity of the power lift and the capacity of the auxiliary control valves.

On the other hand, excessively high valve settings create dangerous conditions of stress on all the components involved.

At the end of the tests, use the relative adjusters to ensure that the valve settings are correct.

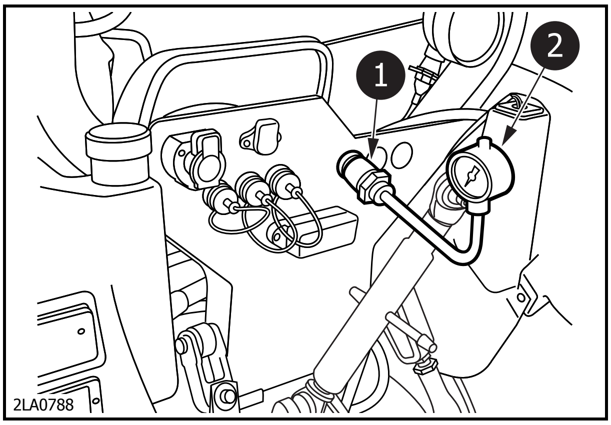
The hydraulic tests must be conducted with the engine at a rate of about 1200 RPM, with oil at a temperature between 30 - 40 °C, using the necessary special tools and a set of pressure gauges.

Checking the valve pressure setting for the auxiliary control valves

Insert union **004 IDR MIS** (1) into a quick-connecting female half-coupling and connect it to the pressure gauge (2) with 0 - 250 kg/cm^2 scale.

Operate the lever of the valve system for the half-coupling in question and activate the valve.

Check the pressure reading on the gauge. It must be 185 - 190 bar (188 - 193 kg/cm^2).



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SECTION 710

HYDRAULIC CIRCUITS – AUXILIARY CONTROL VALVES

INDEX

Description **Page**

MAIN SPECIFICATIONS

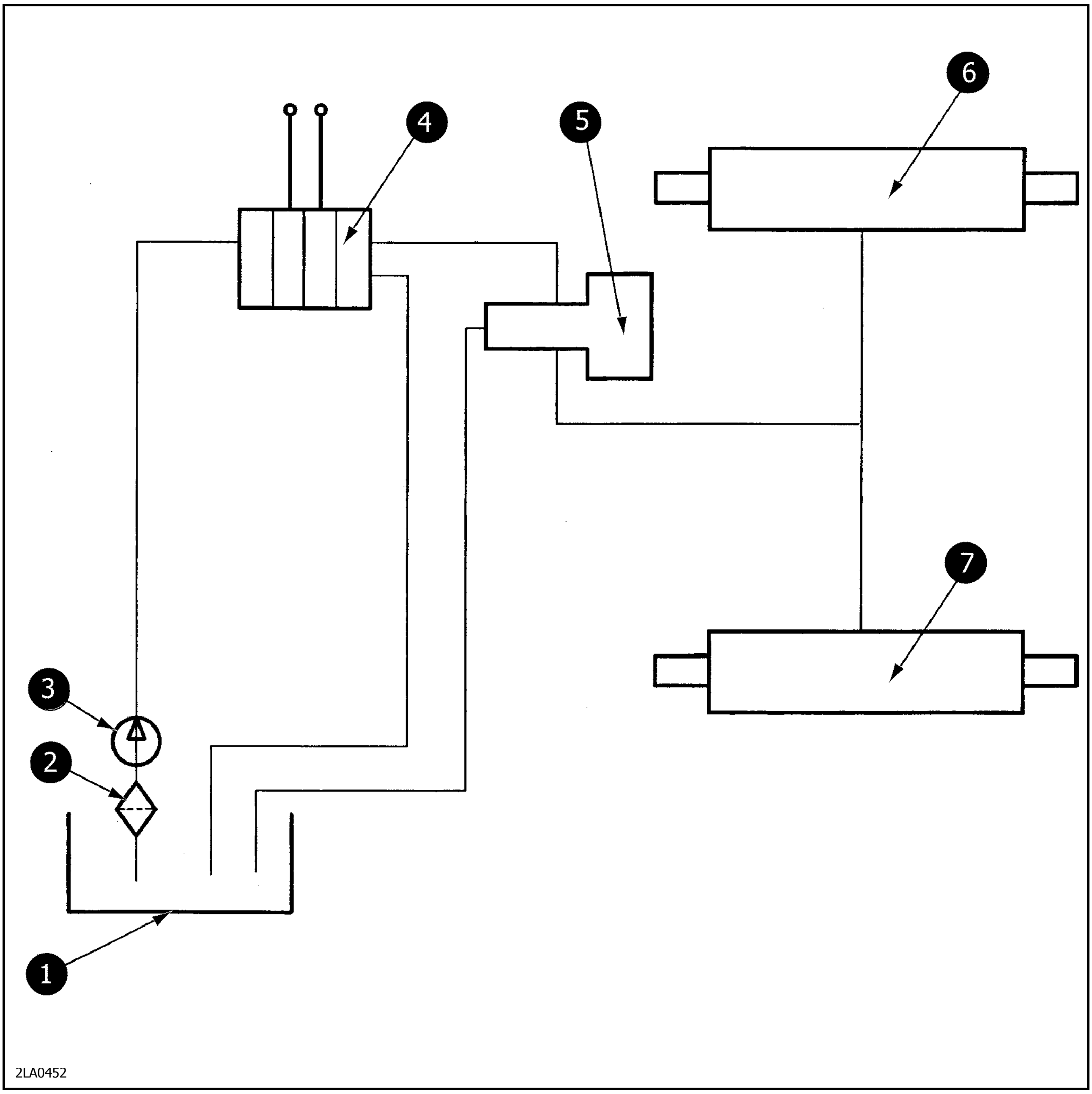
Make		Hidrocontrol
Operation		Standard-Single/double acting, floating
Type		With open center and quick couplings
Calibration valve	(bar)	185 - 190
Maximum flow rate	(l/min)	28 - 36
Maximum quantity		3 elements
Connection to the circuit		In series
Position		At the rear

1

Longitudinal section of auxiliary control valve

DESCRIPTION AND OPERATION

Fig. 2 gives a schematic view of the hydraulic circuit of the power lift and auxiliary control valves.



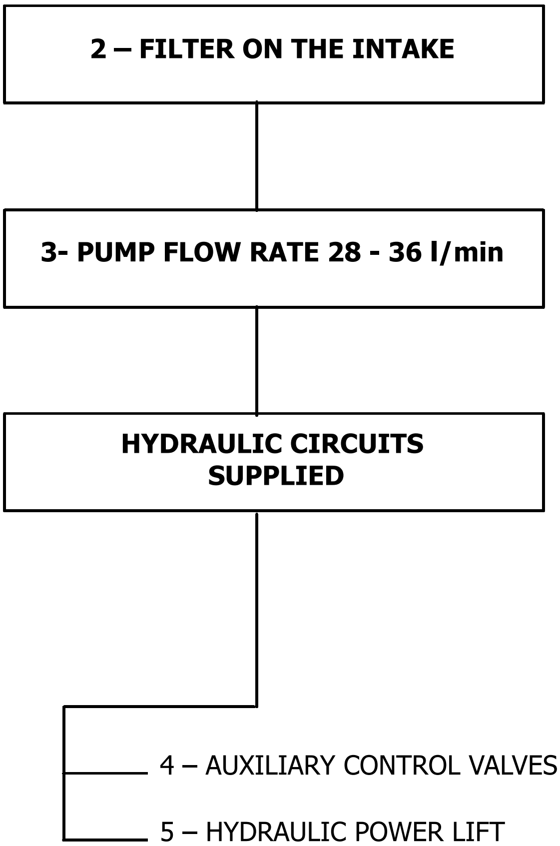
2

1. **1.** Reservoir
2. **2.** Filter
3. **3.** Pump
4. **4.** Auxiliary control valves
5. **5.** Power lift valve system
6. **6.** RH cylinder
7. **7.** LH cylinder

Description of the circuit

Oil in the reservoir (1) is drawn in by the pump (3) after passing through the filter (2) and is sent to the auxiliary control valves (4) as absolute priority. If the auxiliary control valves are not being used, the oil passes through them and supplies the valve system of the hydraulic power lift (5) plus, if activated, the lifting cylinders (6).

When the auxiliary control valve is activated, the oil supplies the cylinder to which it is connected, using the entire flow rate of the pump.



Description of the auxiliary control valves

The auxiliary control valves used are the open-center type with "Push-Pull" quick couplings. They are available in the versions listed below:

- Basic version: rear 4-ways controlled by two standard control valves convertible from single to double acting.
- Optional version: rear 6-ways controlled by two standard control valves and 1 floating control valve convertible from single to double acting.
- Optional version: rear 4-ways /front 2-ways controlled by two conventional rear control valves and 1 floating control valve for front use (convertible from single to double acting).

SECTION 800

STEERING SYSTEM

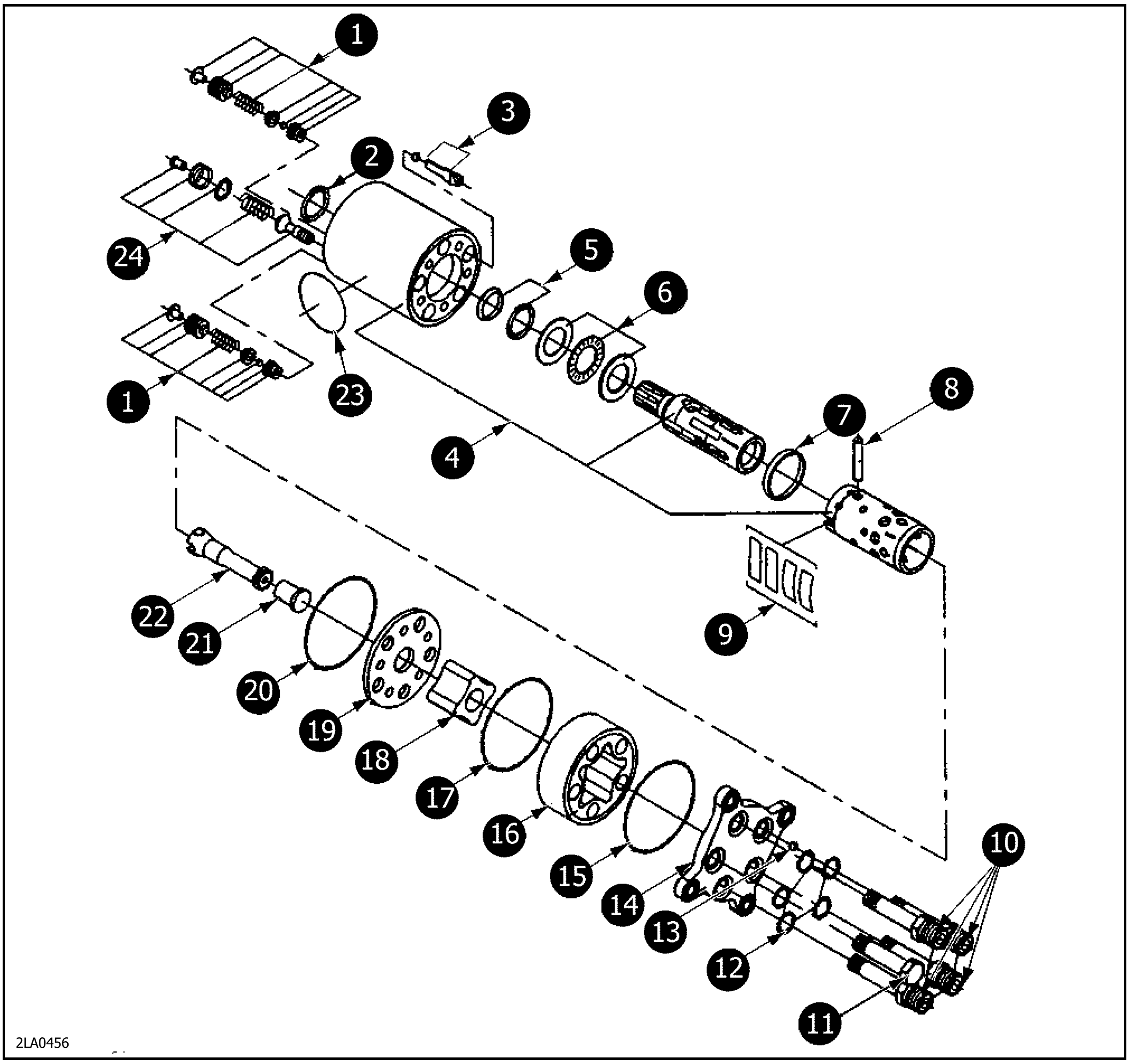
INDEX

MAIN SPECIFICATIONS

Pump		
Type		Double gear type (in tandem)
Make		Bx
Model		A - 510 - 845 - 262
Engine/pump RPM ratio		1:1.25
Maximum operating pressure	(bar)	160 - 165
Maximum flow rate at 2600 RPM engine rate	(l)	11
Position		Front left side of engine
Drive		Valve system gears
Filters		
Type (on the intake)		With cartridge
Filtering degree	(μm)	40
Steering system		
Type		Power steering controlled by the steering wheel
Steering wheel		Adjustable tilt
Pump		Gear type, 11 l/min at top engine rate
Filter		In paper on the intake
Steering cylinder		Double acting, balanced
Maximum operating pressure	(bar)	110
Maximum turning radius	(m)	3.15 (1)

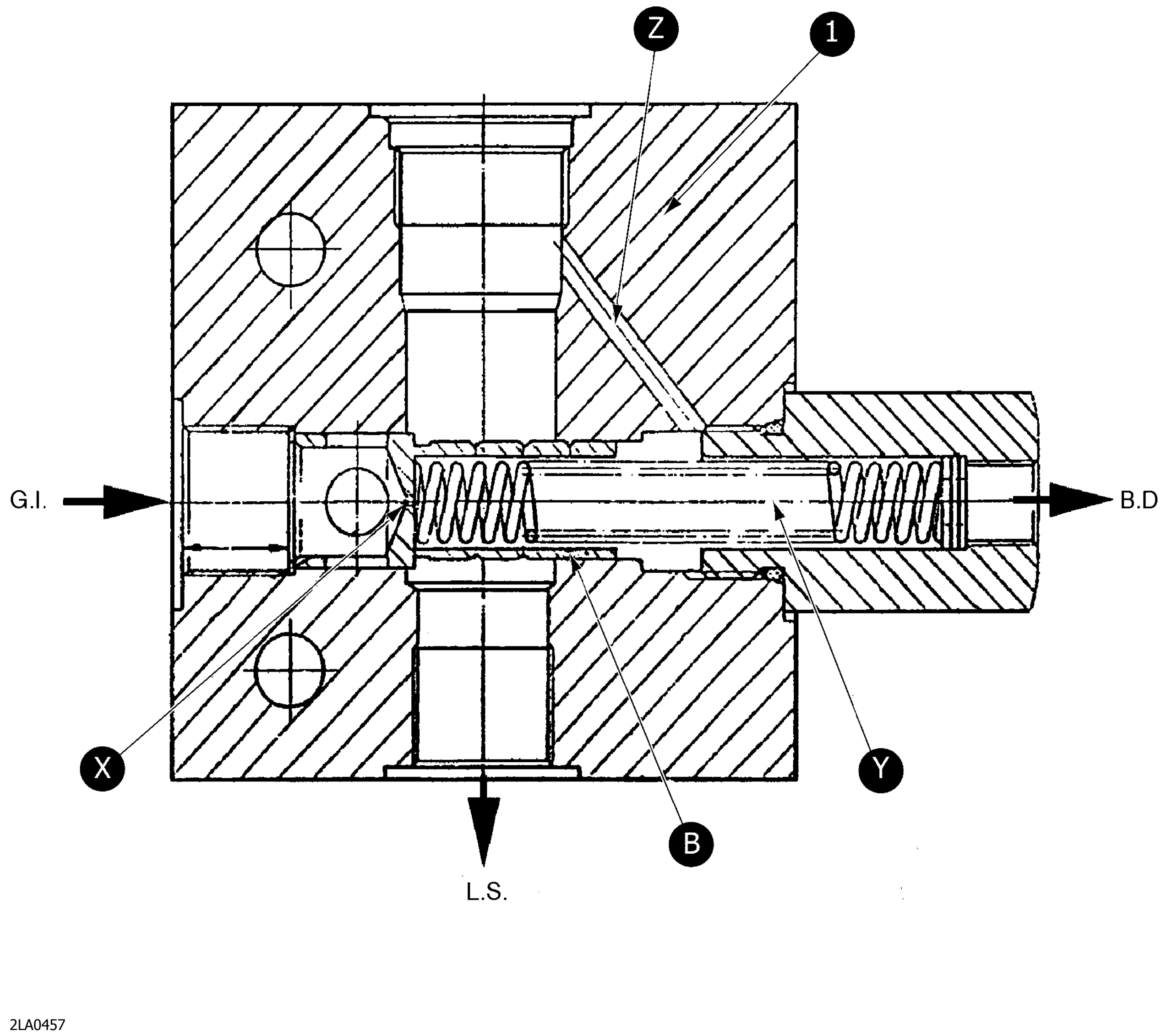
(1) Value to obtain with 280/70R16 front and 360/70R24 rear tyres.

SECTIONS AND EXPLODED VIEWS



1

1. **1.** Cylinder safety valve
2. **2.** Dust guard ring.
3. **3.** Return valve
4. **4.** Body, rotating valve and rotating valve seat sleeve of the valve system
5. **5.** Seal
6. **6.** Thrust bearing
7. **7.** Spring retention ring
8. **8.** Sleeve conveying pin-rotor control shaft
9. **9.** Spring to return sleeve to the neutral position
10. **10.** Oil inlet/outlet unions
11. **11.** Fixing screw
12. **12.** Retention ring
13. **13.** Non-return valve
14. **14.** Cover
15. **15.** Retention ring
16. **16.** Fixed ring for rotor
17. **17.** Retention ring
18. **18.** Rotor
19. **19.** Shimming ring
20. **20.** Retention ring
21. **21.** Spacer
22. **22.** Rotor control shaft.
23. **23.** Identification plate
24. **24.** Over-pressure valve



2

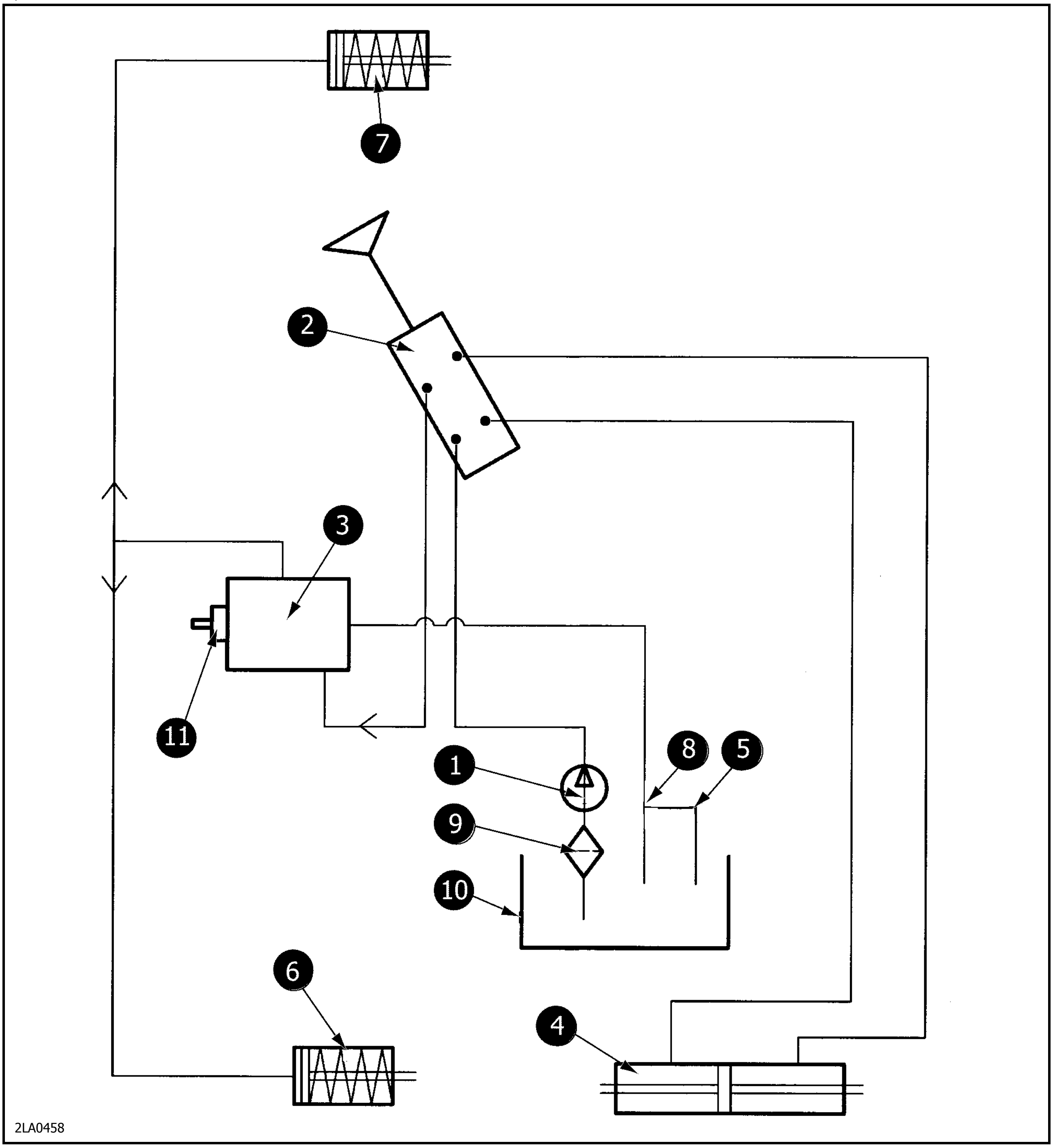
Longitudinal section of the utility pressure governor valve (18 bar)

1. Utility pressure governor valve (18 bar)
B. Plunger
X. Calibrated hole
Y. Chamber

Z. Channel
B.D. to diff locks
G.I. to power steering system
L.S. to lubrication and outlet

DESCRIPTION AND OPERATION

Fig. 3 gives a schematic view of the hydraulic circuit of the low pressure hydraulic circuit.



3

Power steering circuit layout

1. Pump
2. Steering control system
3. Utility pressure governor valve
4. Steering cylinder
5. Reverse shuttle lubrication
6. Front differential lock
7. Rear differential lock
8. Gearbox lubrication
9. Filter
10. Reservoir
11. Solenoid valve

The diagram below gives a brief description of the circuit:

Oil in the reservoir (10) is drawn in by the internal stage of the pump (1) through a single hose, after passing through the filter (9), and is sent to the steering valve system (2) as absolute priority. Thus supplied, the power steering valve system can either use the oil to supply the steering cylinder (4) under the control of the safety valve (160 - 165 bar), or direct it towards the outlet as supply line of the utility pressure governor valve (3).

This valve (3) is permanently supplied, as oil from the pump always flows to the outlet of the power steering valve system both when the function is not being used and when the supply is in excess. Thus supplied, the unit ensures that there is the correct pressure for activating the front and rear diff locks (6-7) where necessary. Drained oil returns from the valve (3) to the gearbox-transmission housing after having lubricated the reverse shuttle (5) and gearbox (8) with a mist spray.

9 – FILTER ON THE INTAKE

1 – MAXIMUM PUMP FLOW RATE AT 2600 RPM, 11 l/min

HYDRAULIC CIRCUITS SUPPLIED

2 - POWER STEERING CIRCUIT
Maximum operating pressure 160 P 165 bar

3 – PRESSURE REGULATING VALVE FOR UTILITIES

4 – STEERING CYLINDER

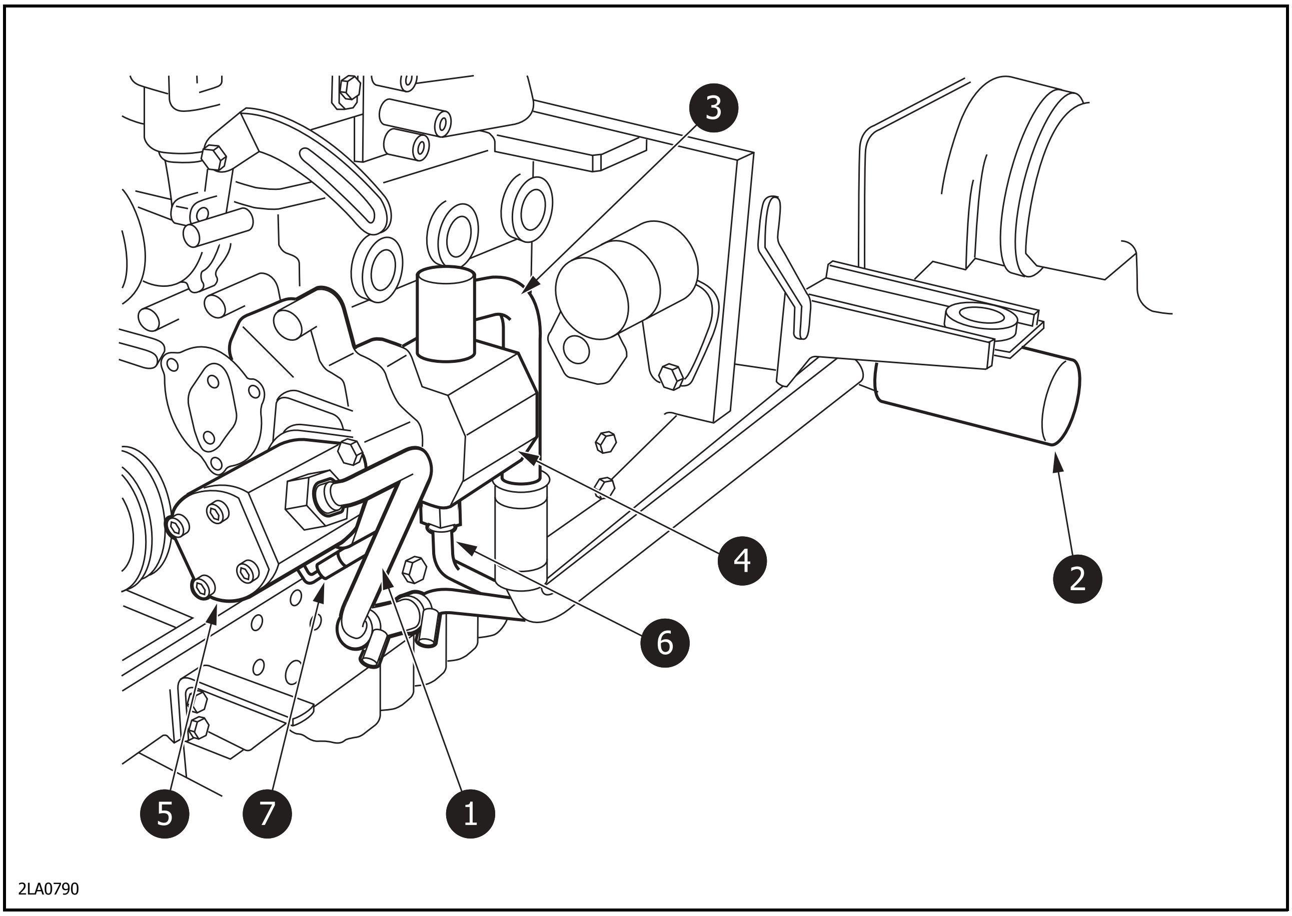
5 – REVERSE SHUTTLE LUBRICATION

6 – FRONT DIFF LOCK

7 – REAR DIFF LOCK

8 – GEARBOX LUBRICATION

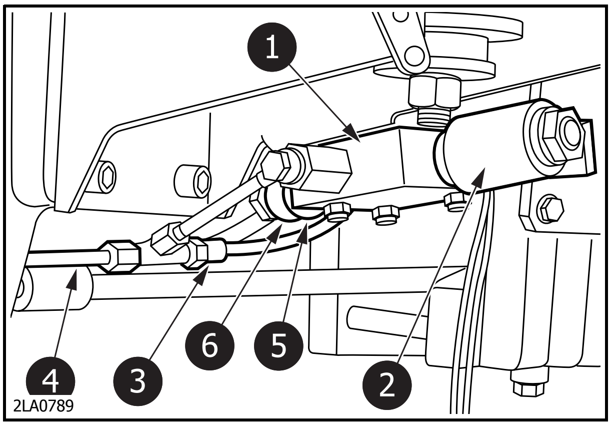
Note the hydraulic pump in fig. 4 and the relative pipes with reference to the intake and delivery hoses for the power steering circuit and utilities, and for the hydraulic power lift circuit.



4

1. Intake pipe for the power steering circuit and utilities
2. Filter
3. Intake pipe for the hydraulic power lift circuit
4. Hydraulic poser lift control pump
5. Control pump for the power steering circuit and utilities
6. Delivery pipe for the hydraulic power lift circuit
7. Delivery pipe for the power steering circuit and utilities

To complete the description, remember that oil from the power steering system reaches the plunger (B, fig. 2) of the valve (1) after which it passes through the calibrated hole (X, fig. 2) and enters the chamber (Y, fig. 2). If the solenoid valve (2) is not energized, the oil flows through the channel (Z, fig. 2) until it reaches the outlet and lowers the pressure in the chamber (Y, fig. 2) to 0. Oil from the power steering system moves the plunger (B, fig. 2) towards the left and the entire oil flow goes to the outlet after having lubricated the reverse shuttle through pipe (6) and the gearbox through (5). If solenoid valve (2) is energized, the oil in chamber (Y, fig. 2) will no longer be in communication with the outlet, thus it will supply the front (3) and rear (4) diff locks.



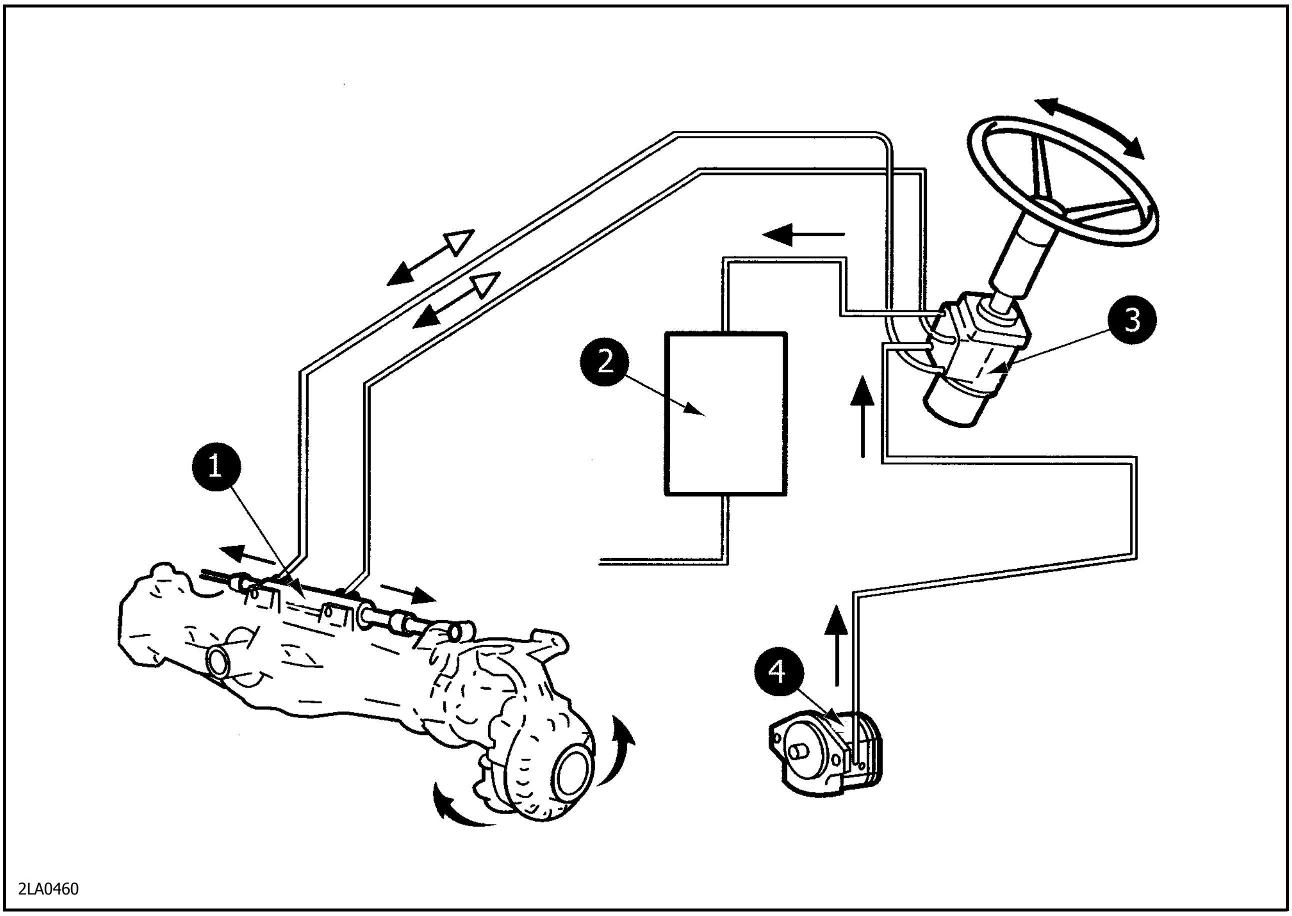
5

Power steering circuit oil supply

The circuit of the power steering system and utilities includes a first high pressure section to operate the actual power steering system itself.

Oil from the pump (4) supplies the power steering valve system (3) and then controls the relative steering cylinder (1).

Oil leaving the power steering system supplies the rear diff lock (2). There is no mechanical connection in the power steering system between the steering wheel and steering cylinder. Each minimum turn of the steering wheel corresponds to an equivalent turn of the wheels. If the engine breaks down or the hydraulic pump fails to operate, the power steering valve system acts like a hand pump operated by the steering wheel which allows the turn to be made.



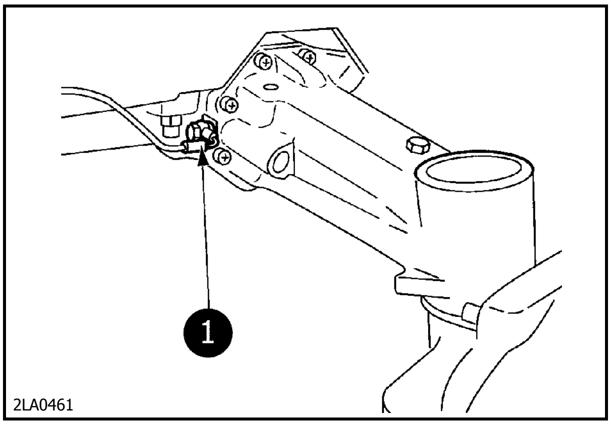
6

1. Steering cylinder
2. Rear differential
3. Valve system
4. Pump

Differential locking and unlocking

Operating principle

The differentials (front and rear) are locked through the movement of two mechanical clutch assemblies activated by a piston with oil at a pressure of 18 bar (1, fig. 7 for the front differential and 1, fig. 8 for the rear differential).



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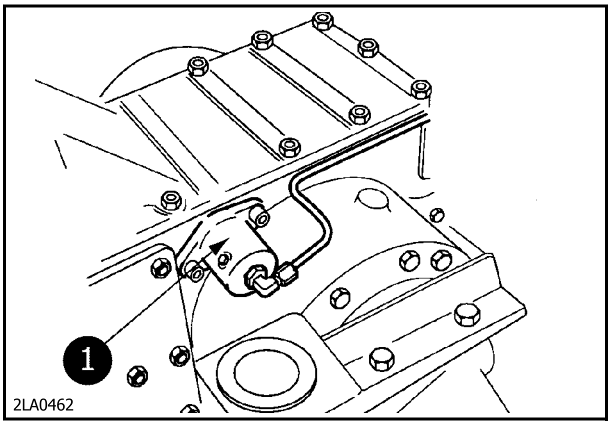
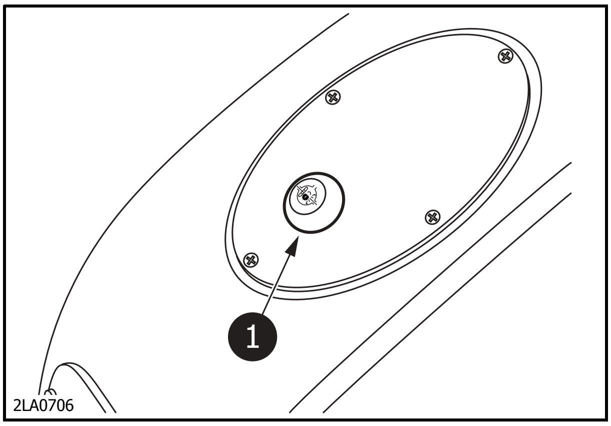


8

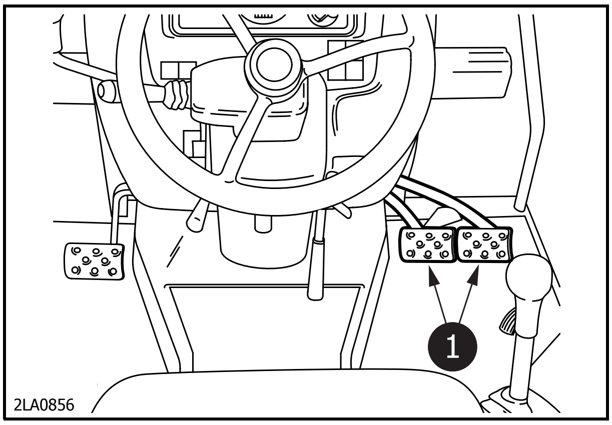
Proceed in the following way:

- **Locking**
  Press the control button (1) to energize the solenoid valve that allows the oil to supply the front lock (1, fig. 7) and rear lock (1, fig. 8) at the same time.



9

- **Unlocking**
  Operate the brake pedals (1) to de-energize the solenoid valve and stop the oil flow, opening the route towards the outlet while the internal return springs set the two locking mechanisms to the hold position, deactivating the action on the two respective differentials.



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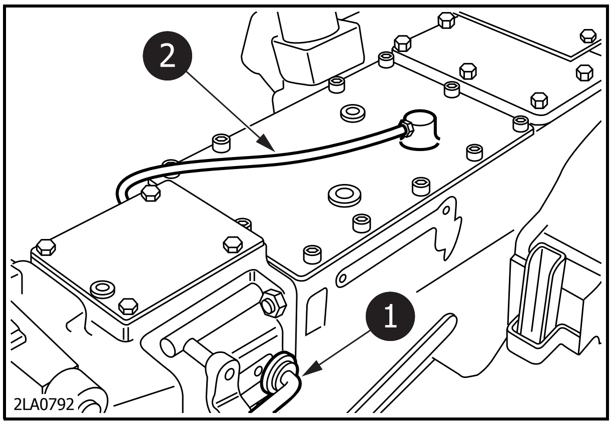
Reverse shuttle and gearbox lubrication

As can be seen in the block diagram on page 8, the hydraulic circuits that lubricate the reverse shuttle and gearbox are supplied by the power steering control pump. In particular, the oil from the utility pressure governor valve outlet lubricates the reverse shuttle synchromesh (1) and the gearbox (2).



11

OPERATING PRESSURE TESTS

Foreword

The operating pressure test must be conducted whenever faults are encountered or when the tractor is generally overhauled.

Remember that if the safety valves in the circuit have a low pressure setting, this may prevent the various components from meshing correctly and cause them to operate in a faulty way.

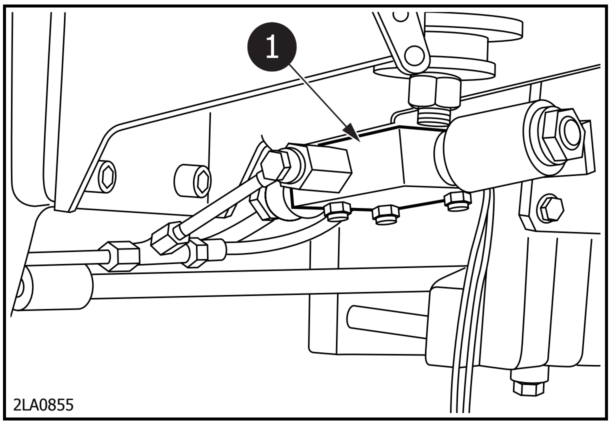
On the other hand, an excessively high valve pressure setting could stress all the components in question and, in the case of the valve that controls the lubricating pressure, cause all the transmission retention rings to break. At the end of the tests, use the relative adjusters to ensure that the valve settings are correct.

The hydraulic tests must be conducted with the engine at a rate of about 1000 RPM, with oil at a temperature between 30 - 40 °C, using the necessary special tools and a set of pressure gauges.

Steering circuit pressure test

Mount the union on the steering cylinder and connect a pressure gauge with a 0 to 250 kg/cm^2 scale.

When the steering cylinder reaches end of stroke, the pressure gauge must give a reading between 160 - 165 bar.

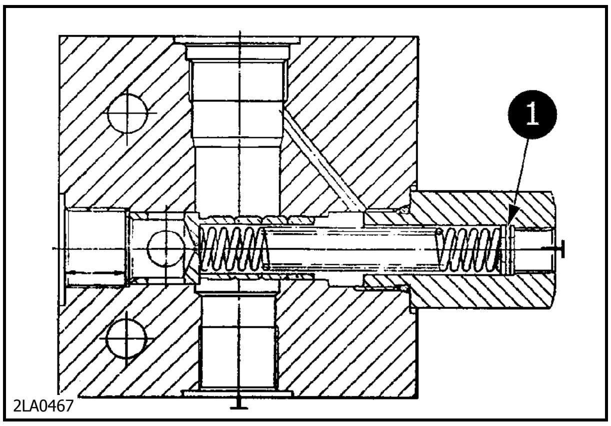


12

Checking the pressure setting of the utility pressure governor valve (18 bar)

Fit an adequate union on the valve (1, figure 12) and connect a 0 to 60 bar pressure gauge.
Start the engine and attempt to engage the diff locks. The pressure gauge must indicate 18 bar.

Use the shims (1) to adjust the valve.



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SECTION 900

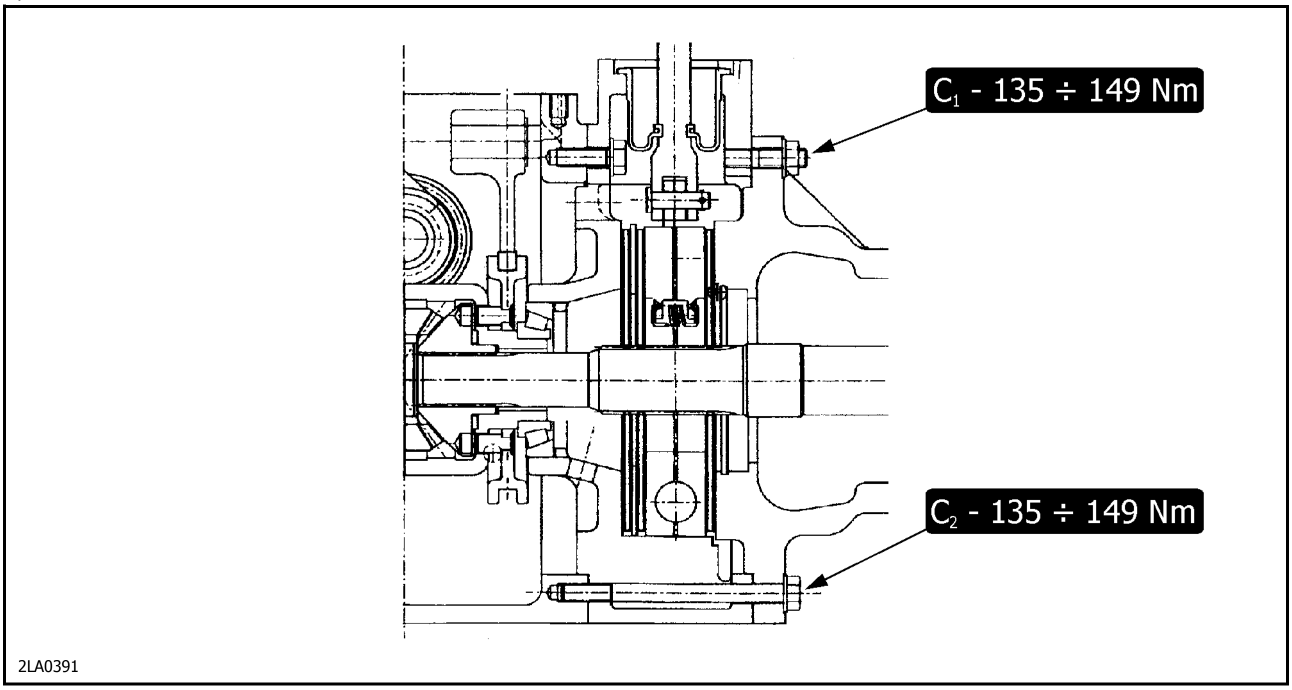
BRAKES

INDEX

MAIN SPECIFICATIONS

Type:	
- main brake	with oil-cooled discs acting on the half-shafts of the differential
- parking brake	with oil-cooled discs acting on the half-shafts of the differential
Control:	
- main brake	mechanical, with separate pedals (cal be latched together by means of a pin)
- parking brake	mechanical, with a lever
- Main brake disc material	sintered
- Parking brake disc material	sintered

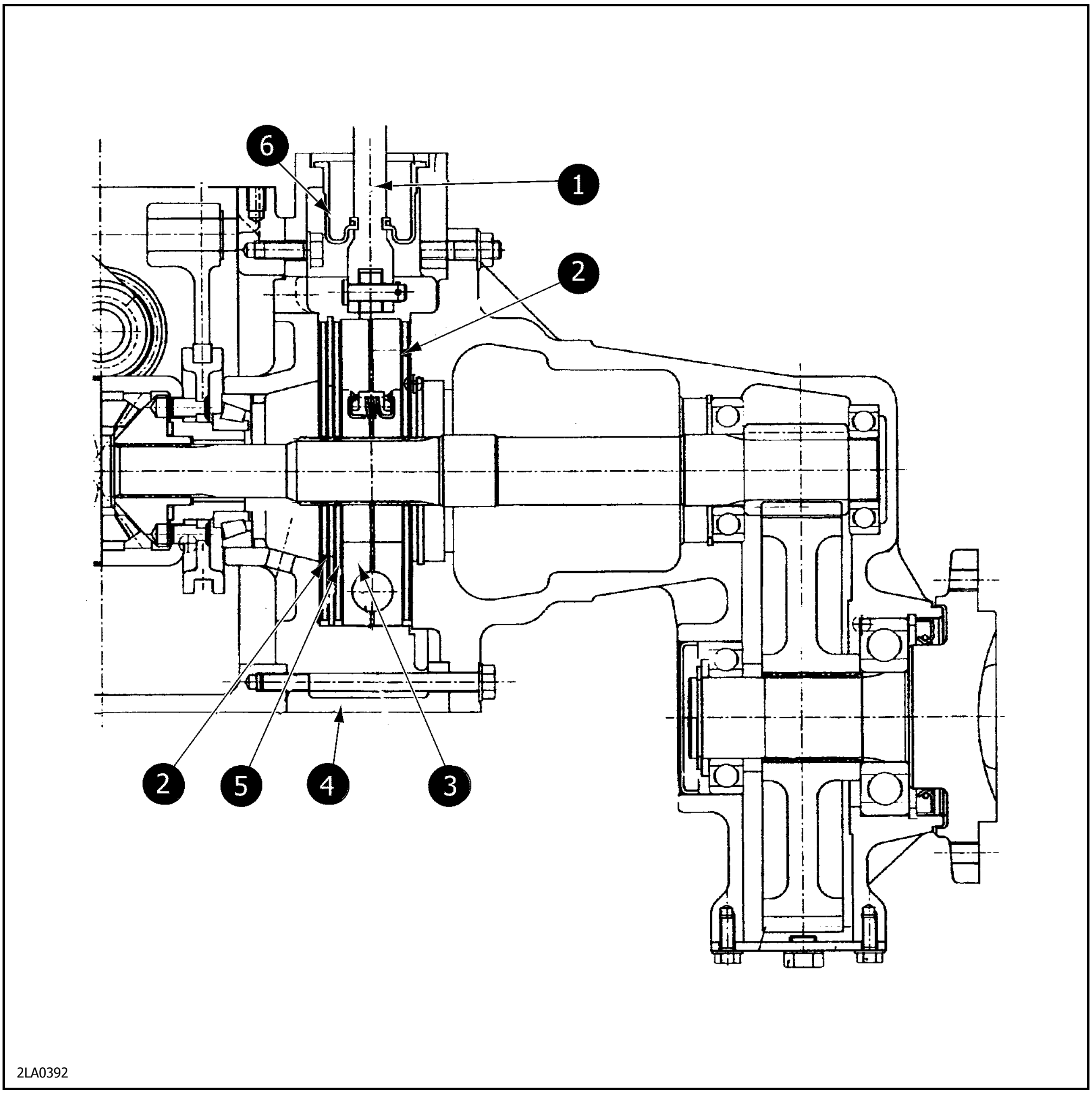
DRIVING TORQUE VALUES



1

PARTS TO TORQUE	Thread	Driving torque values	
		Nm	kgm
Nuts fixing final drive housing to the transmission housing (C_1)	-	135 - 149	13.8 – 15.2
Nuts fixing final drive housing to the transmission housing (C_2)	-	135 - 149	13.8 – 15.2

SECTIONS



2

Section drawing of main and parking brake systems

1. **1.** Rod.
2. **2.** Friction disc.
3. **3.** Pressure plates.
4. **4.** Rear transmission housing.
5. **5.** Steel disc.
6. **6.** Rubber guard.

DESCRIPTION AND OPERATION

Main brakes

The main brakes are the mechanically controlled type with oil-cooled discs.

The two pressure plates (one on each side) are connected by the control rod to the relative pedals with two flexible steel cables.

These pressure plates can be operated both individually and together. However, in this latter condition, the pedals are latched together by a safety pin.

The brake discs (three for each rear wheel) are installed between the rear transmission housing and the side final drive housing. They are shrunk on to the output half-shafts of the differential.

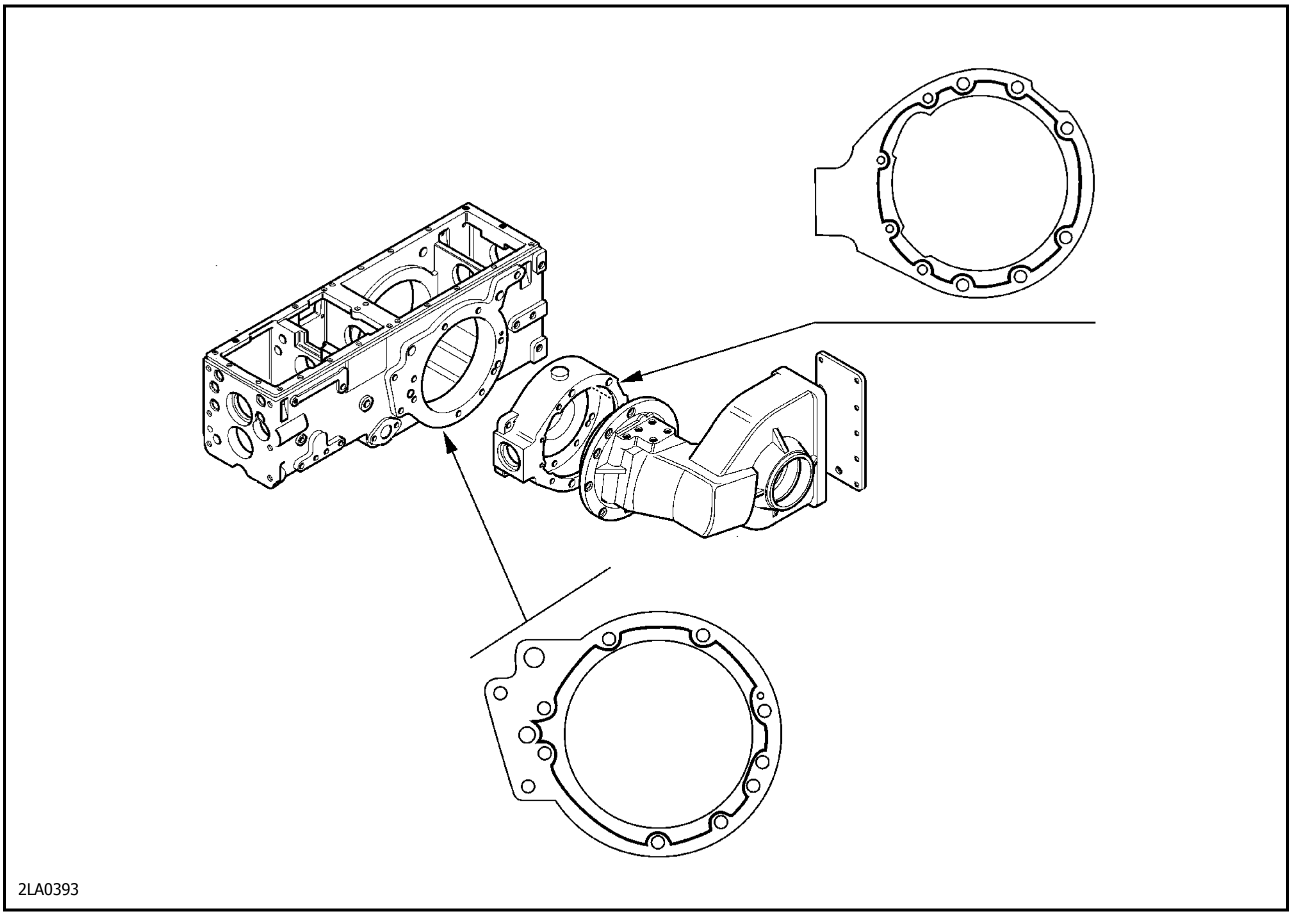
Parking brake

The parking brake is mechanically controlled and acts directly on the main brakes. It is controlled by a lever positioned on the operator’s left.

BRAKE SYSTEM TROUBLESHOOTING

Faults	Possible causes	Remedies
The brake pedals are hard to operate.	The flexible control cable has stiffened.	Release the control cable and replace it if necessary.
The brakes remain engaged when the pedals are released.	The flexible control cable has jammed.	Replace the control cable.
Noisy braking.	Brake disc friction material worn.	Replace the brake discs.
Control pedal travel too long.	Flexible control cable not adjusted correctly.	Adjust correctly.
Braking not balanced.	**1.** Incorrect tyre pressure.	Inflate the tyres to the correct pressure.
	2. Flexible control cable not adjusted correctly.	Adjust correctly.
	3. Brake disc friction material worn on one side.	Replace the discs.
Inefficient braking.	**1.** Brake disc friction material worn.	Replace the brake discs.
	2. Flexible control cables not adjusted correctly.	Adjust correctly.
The parking brake fails to engage.	**1.** Brake control not adjusted correctly.	Adjust correctly.
	2. Brake disc friction material worn.	Replace the brake discs.
The tractor remains braked when the parking brake is disengaged.	**1.** Impediments in the return travel of the control.	Remove the impediments.
	2. The flexible control cable has jammed.	Replace the control cable.

WHERE THE SEALANT IS APPLIED ON THE BRAKE ASSEMBLY AND SIDE FINAL DRIVES ON THE TRANSMISSION HOUSING



3

The types of sealant to apply are indicated in section 100.

RIGHT OR LEFT BRAKE SPLITTING-REMOUNTING

Splitting

DANGER

Lift and handle all heavy parts with lifting equipment of an adequate capacity.
Make sure that the units or parts are supported by appropriately sized harness and hooks.
Make sure that there are no bystanders near the load being lifted.

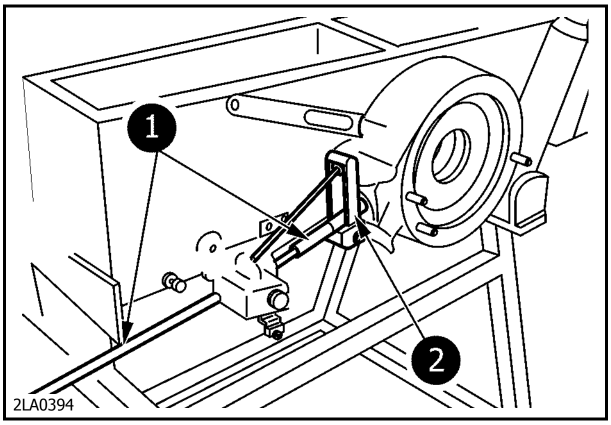
WARNING

Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Proceed as follows:

1. Split the right or left side final drive housing.

2. Disconnect the flexible control cable (1) and demount the brake control rod (2).



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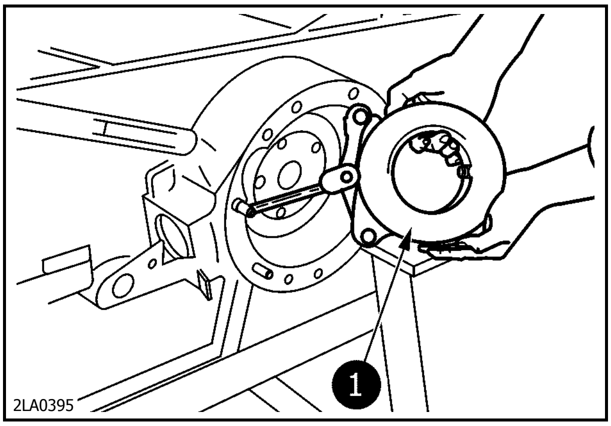
3. Remove the complete brake assembly (1).
Avoid damaging the seal of the brake control rod.



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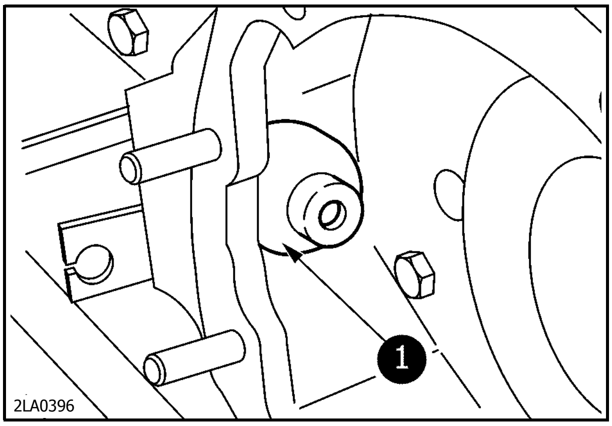
Remounting

> **WARNING**
> Handle all parts with great care. Do not put your hands or fingers between one part and the next. Wear approved safety garments such as goggles, gloves and safety footwear.

Comply with the following instructions when remounting the right or left brake:

- Check the seal of the brake control rod (1) and replace it if necessary.
- Mount the complete brake assembly, taking care to prevent the seal of the brake control rod from being damaged.
- Mount the brake control linkage and re-connect the flexible control cable.
- Fit the right or left side final drive housing back in place.



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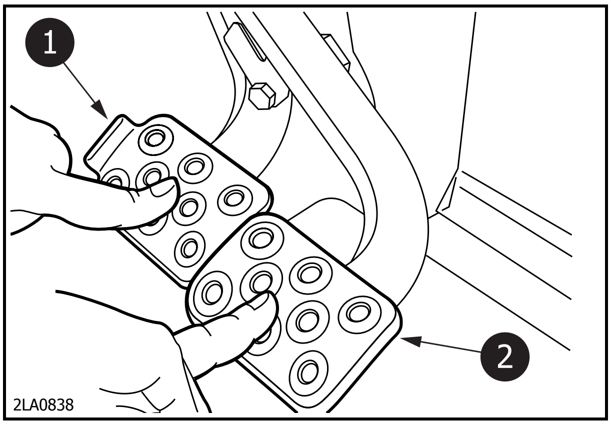
ADJUSTMENTS

Make sure that the idle travel of the two left (1) and right (2) brake pedals is the same and that it corresponds to 30 – 35 mm. Proceed in the following way if this is not the case.



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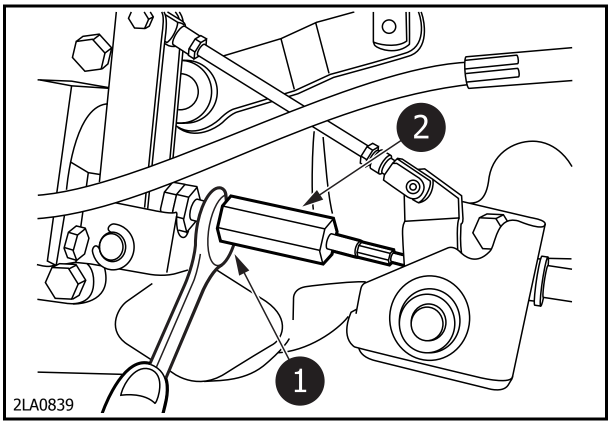
Adjustment of the right and left brakes

1. Jack up the rear wheels.
2. Make sure that the parking brake is not engaged and remove the latch that joins the pedals together.
3. Loosen the check nut (1) and screw in the adjuster (2) until the wheel has locked.
4. Unscrew the adjuster about one and a half turns. Lock the check nut and check that the wheel is free to turn (repeat the same operations on the opposite wheel).



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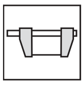
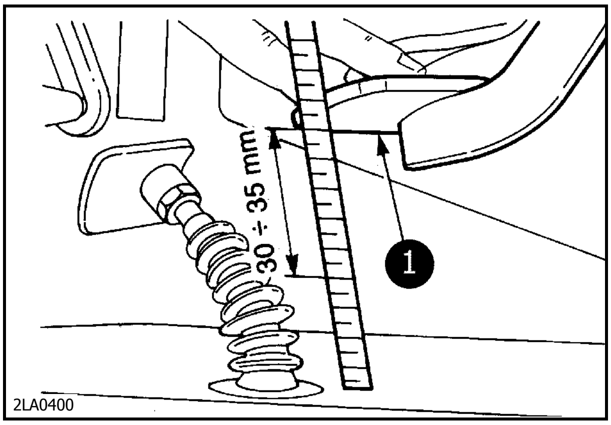


5. Simulate a few braking actions, then check to make sure that the travel of the right brake pedal (1) is between 30 and 35 mm. Repeat the adjustments if this is not the case.



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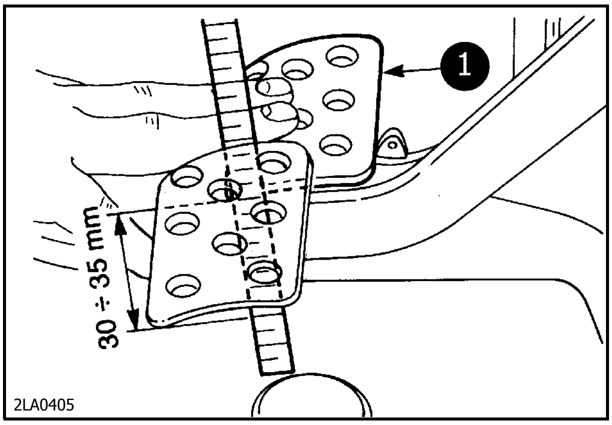
6. Simulate a few braking actions, then check to make sure that the travel of the left brake pedal (1) is between 30 and 35 mm. Repeat the adjustments if this is not the case.



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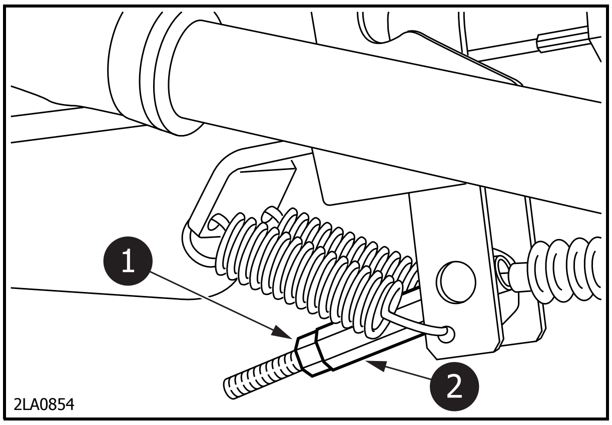
Parking brake hand lever travel adjustment

Make sure that the parking brake lever engages at the second position of its travel. Proceed in the following way if this is not the case:

1. Loosen the check nut (1) and regulate the adjuster (2).

2. Lock the check nut.



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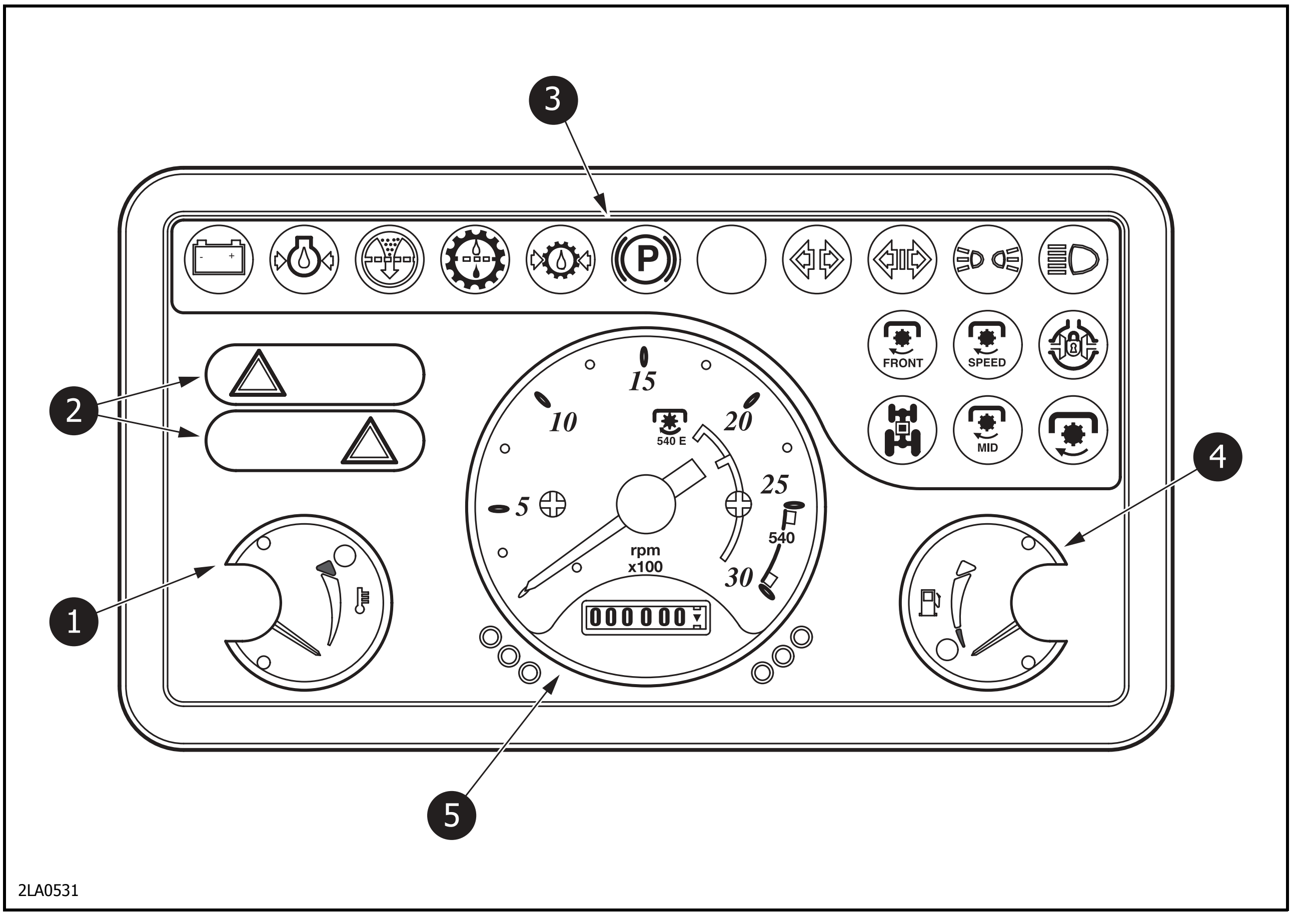
SECTION 1000

ELECTRICAL SYSTEM - INSTRUMENTS

INDEX

INSTRUMENTS

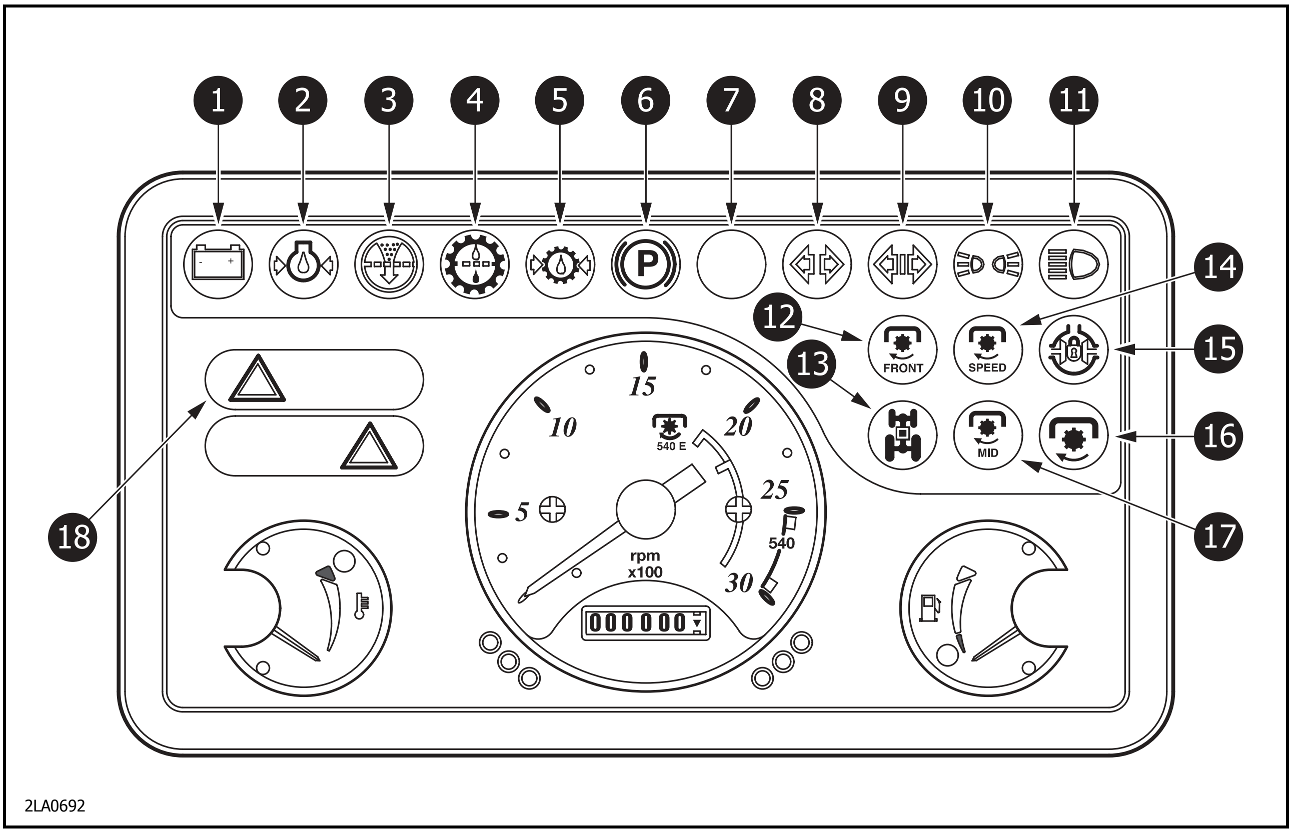


1

The instrument on the control panel is divided into four sections:

1. Engine coolant temperature instrument
2. General warning light
3. On/off and warning lights
4. Fuel level gauge
5. RPM meter and hour counter

Warning light identification



2

Instrument panel

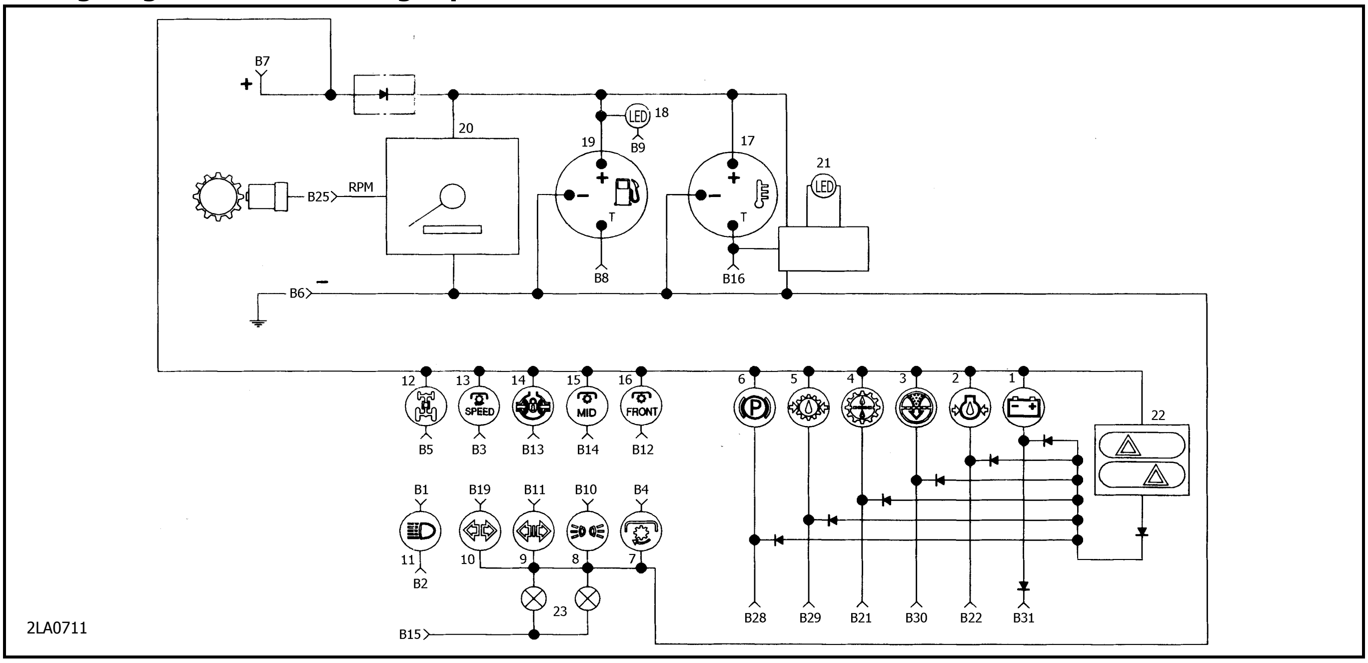
WARNING LIGHTS - RED

1. Battery charging warning light. Should go out as soon as the engine starts.
2. Engine oil pressure warning light. Should go out as soon as the engine starts. It is quite normal for this light to come on if a hot engine is left to idle.
3. Dry air filter blockage warning light.
4. Warning light for transmission and hydraulic system filter blockage. (Only for hydrostatic version).
5. Warning light for low pressure in hydraulic transmission system. (Only for hydrostatic version).
6. Red light. Parking brake engaged.

FUNCTION INDICATORS

7. Not used.
8. Direction indicator light for tractor – green.
9. Direction indicator light for 1st trailer – green.
10. Side light indicator – green.
11. Main beam indicator – blue.
12. Front PTO engaged indicator – orange (if fitted)
13. 4WD indicator – orange. (If fitted)
14. 540 or 540E RPM PTO selector lever indicator – orange.
15. Diff lock indicator - orange.
16. Rear PTO engaged indicator – orange. (Only for hydrostatic version).
17. Under-belly PTO engaged indicator – orange. (If fitted)
18. GENERAL WARNING LIGHT - RED
 Comes on at the same time as one of the red warning lights (1-2-3-4-5-6) or with the red coolant temperature indicator if the component in question is operating in a faulty way. When the key is in the contact position, it must go out as soon as the engine starts.

Wiring diagram of indicator light panel interior



3

Indicator lights

Refer to the table below and the diagram in fig. 3 in order to identify the warning lights in the panel.

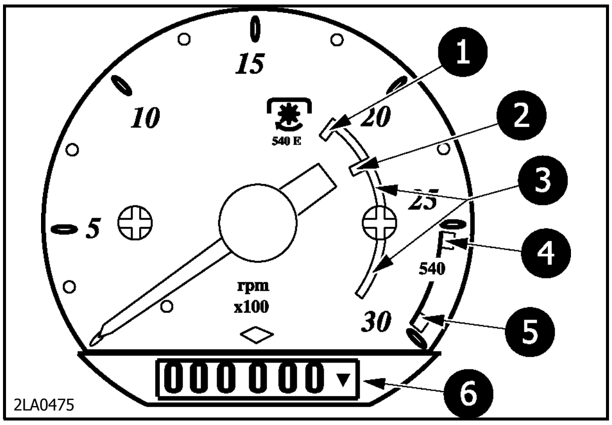
POSITION	DENOMINATION	COLOUR	PIN CONNCTION
1	Battery recharging circuit	RED	B31
2	Insufficient engine oil pressure	RED	B22
3	Air filter clogged	RED	B30
4	Transmission oil filter (*)	RED	B21
5	Electric circuit depression gauge (*)	RED	B29
6	Parking brake engaged	RED	B28
7	Power take-off engaged	ORANGE	B4
8	Side lights	GREEN	B10
9	Side lights of 1st trailer	GREEN	B11
10	Turn indicators	GREEN	B19
11	Driving beams	BLUE	B1
12	4WD engaged	ORANGE	B5
13	Rear PTO speed	ORANGE	B3
14	Differential lock engaged	ORANGE	B13
15	Underbelly PTO engaged	ORANGE	B14
16	Front PTO engaged	ORANGE	B12
17	Engine coolant temperature indicator instrument	-	B16
18	Fuel reserve	RED	B9
19	Fuel level gauge instrument	-	B8
20	RPM counter and hour counter instrument	-	B25
21	Engine coolant temperature high	RED	-
22	General warning light	RED	-
23	Instrument panel lights	WHITE	B15

(*) Hydrostatic version only

RPM meter and hour counter

Engine RPM is shown on an analogue gauge on which, as RPM increases, a pointer moves around a graduated scale. The pointer should never reach the red zone which shows excessive engine speed. The green zone, with the PTO symbol, indicates the nominal engine rate.

1. Green limit – corresponds to the 540E RPM PTO at a 1869 RPM engine rate.
2. Red limit – corresponds to the 540E RPM PTO at 630 RPM with a 2181 RPM engine rate.
3. Red sector. Never ever exceed the limit (2) with the 540E RPM PTO selected. The red sector (3) represents the alarm level where the PTO could be seriously damaged.
4. Green limit – corresponds to the 540 RPM PTO at a 2538 RPM engine rate.
5. Red limit – corresponds to the 540 RPM PTO at 630 RPM with a 2961 RPM engine rate. Never ever exceed the limit (5) with the 540 RPM PTO selected. The red sector represents the alarm level where the PTO could be seriously damaged.
6. The hour counter has a six-digit totalizer: the digits on the white background indicate the hours of work, the ones on the yellow background the tenths of an hour and the yellow sector the hundredths of an hour.



4

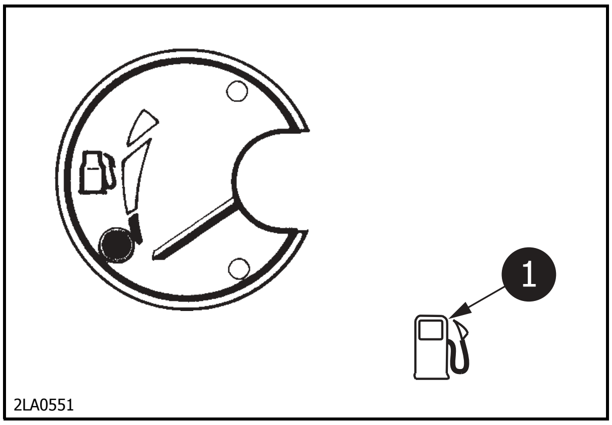
Fuel level gauge

Indicates the level of the fuel in the tank.

The pointer moves fully towards the right when the tank is full.

The pointer moves to the red zone when the tank is less than ¼ full.

It is quite normal for this light to come on if a hot engine is left to idle with the tractor at a standstill.



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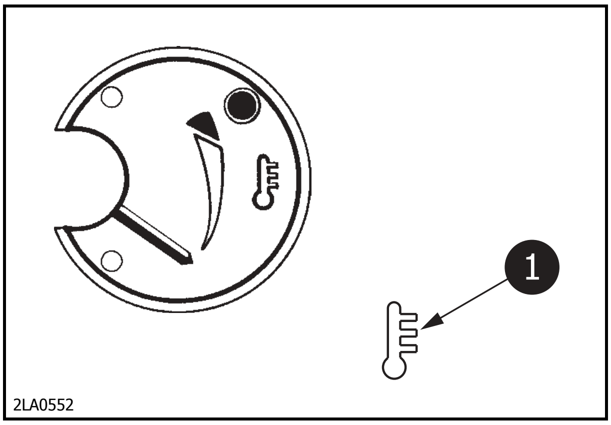
Engine coolant temperature indicator

- Green zone = temperature regular.
- Red zone = engine excessively overheated.

In this latter case, the engine must be allowed to idle (without being stopped). Check the cooling system if the indication persists.

Indicator light (1) on the instrument fig. 6 comes on when the temperature reaches 105-110°C.



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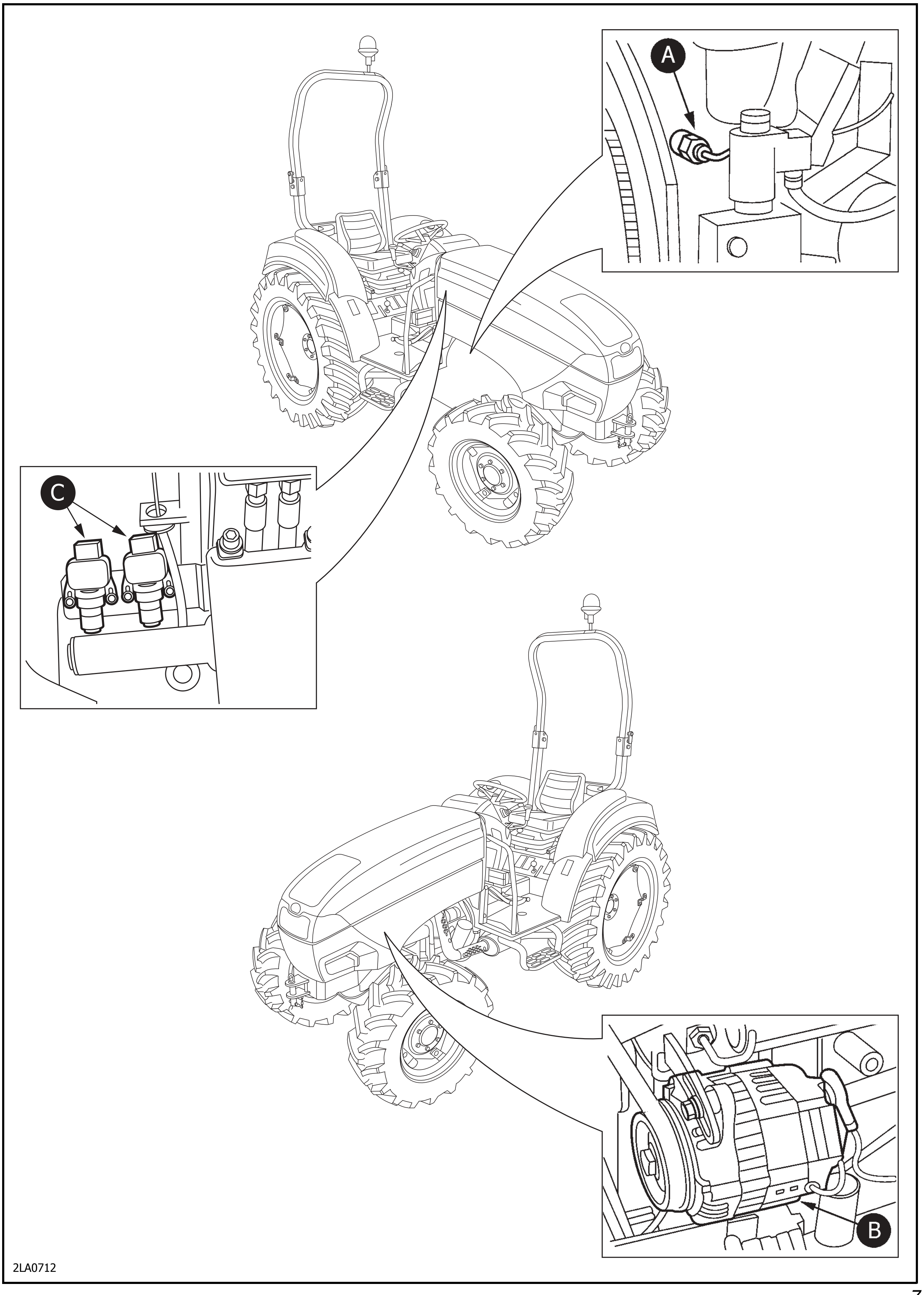
TRANSMITTERS, SENSORS AND SWITCHES



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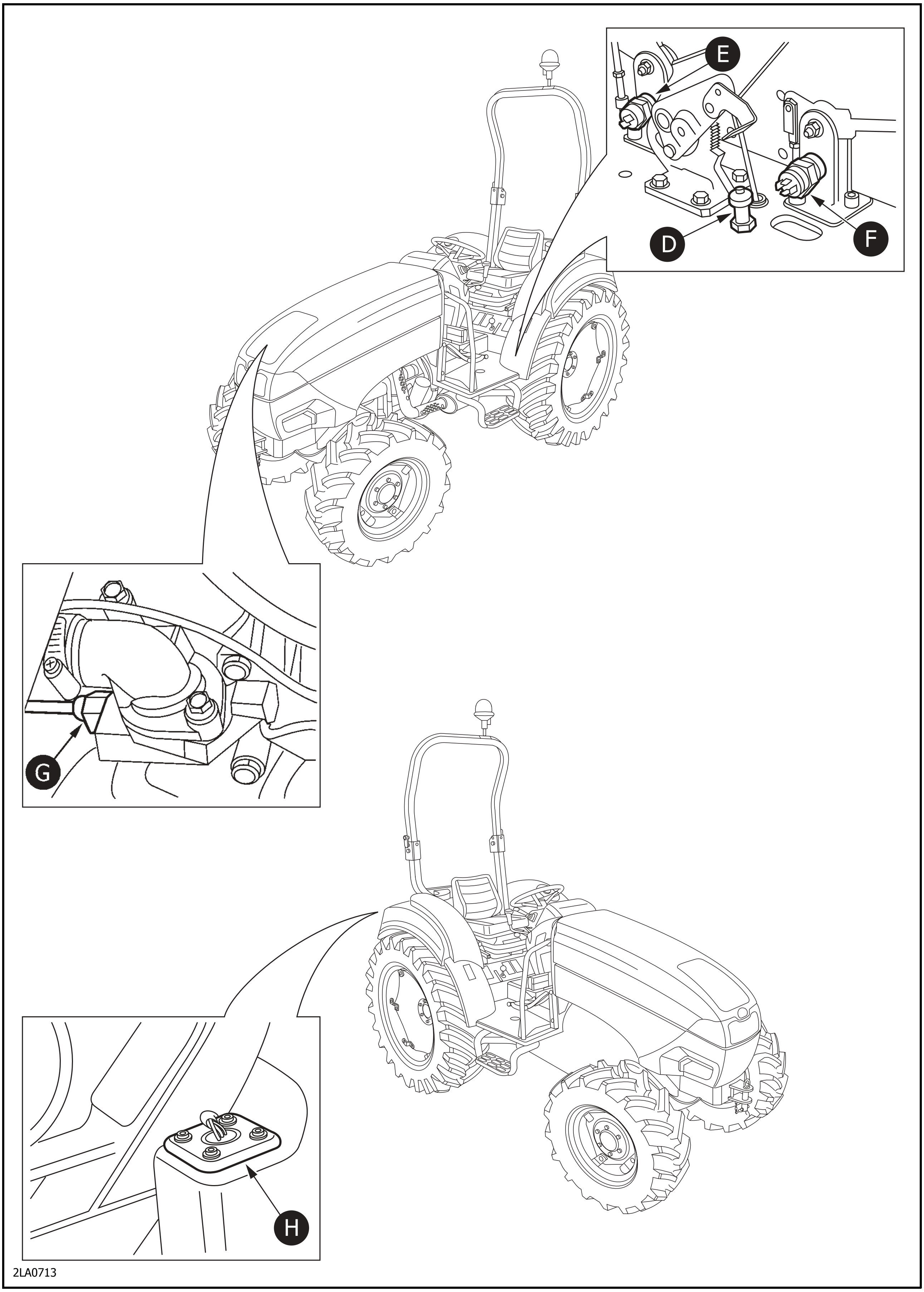
TRANSMITTERS, SENSORS AND SWITCHES



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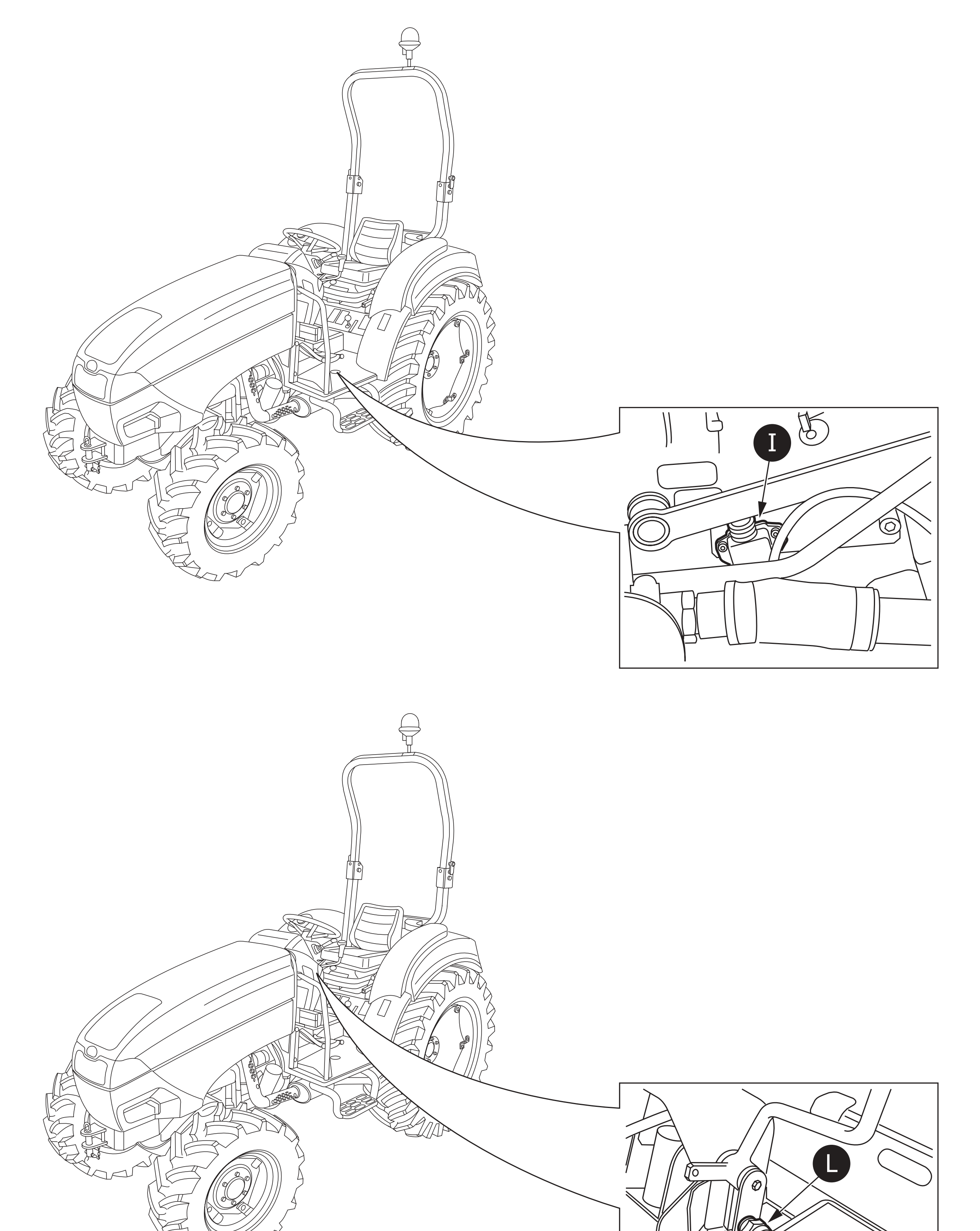
TRANSMITTERS, SENSORS AND SWITCHES



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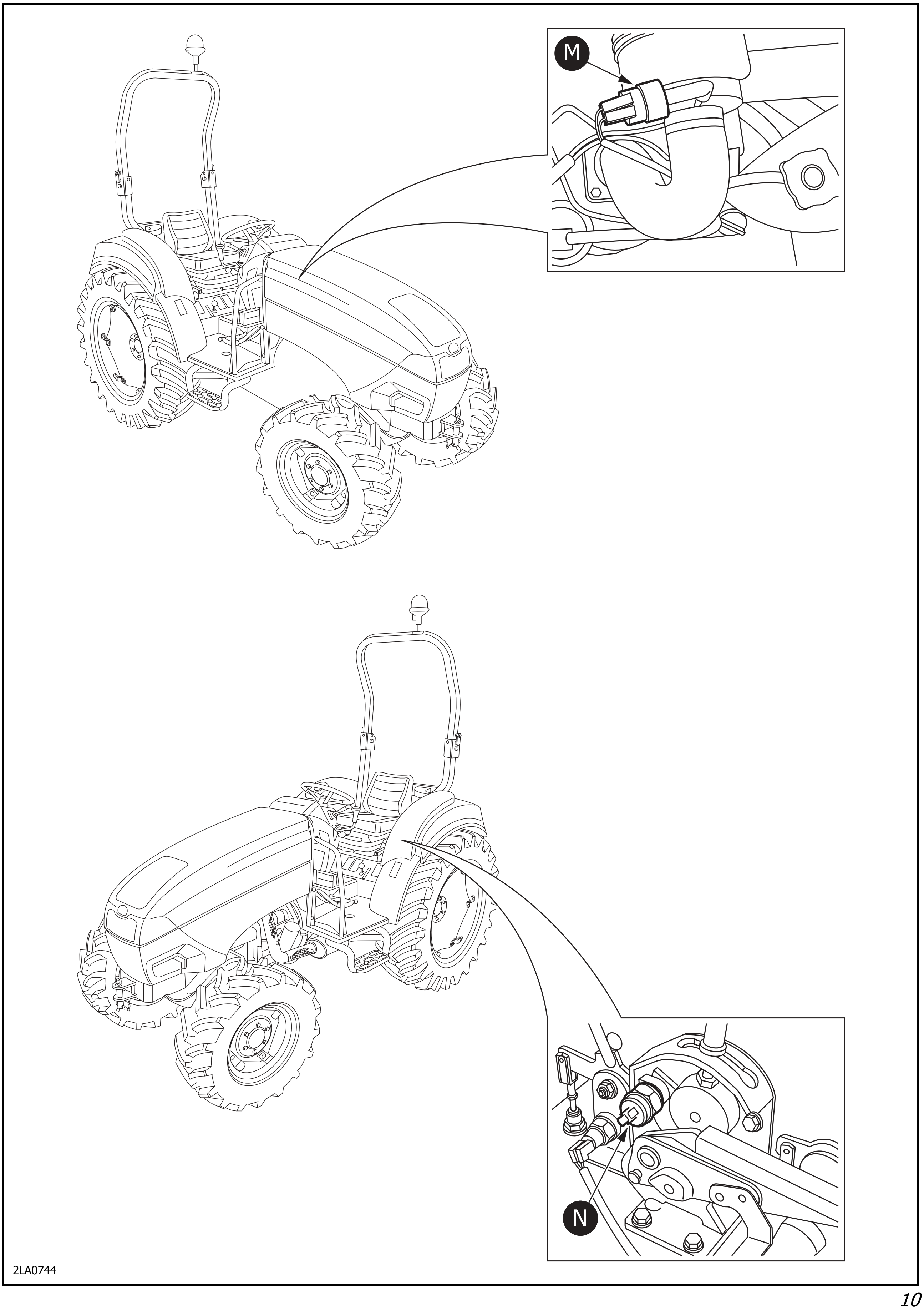
TRANSMITTERS, SENSORS AND SWITCHES



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TRANSMITTERS, SENSORS AND SWITCHES

A. ENGINE OIL PRESSURE SENSOR.
Operates as soon as the pressure of the engine oil drops below a certain value, after which the indicator light on the instrument comes on.

B. ALTERNATOR.
Transmits a square wave signal, recharges the battery and makes up for the power draw depending on the amount required by the users.

C. BRAKE LIGHT SWITCHES.
Operate when the brakes are used. They also release the differential.

D. PARKING BRAKE SWITCH.
This switch makes contact when the parking brake is engaged.

E. REAR PTO SPEED SELECTOR SWITCH

F. FRONT PTO INDICATOR SWITCH.
Operates when the PTO is engaged. The relative light on the instrument also comes on.

G. ENGINE COOLANT TEMPERATURE SENSOR
The resistance of the temperature transmitter varies in proportion to the temperature of the coolant, generating a modulated voltage that is measured by the instrument.

H. FUEL LEVEL TRANSMITTER.
The signal issued by the potentiometer of the transmitter determines the fuel level indicated on the instrument and turns on the warning light when the fuel is in reserve.

I. 4WD INDICATOR SWITCH.
Operates when the pressure of the oil in the 4WD control tube drops and turns on the relative indicator light on the instrument.

L. REVERSE SHUTTLE LEVER SAFETY SWITCH.
Detects the position of the reverse shuttle in order to enable start-up in the neutral condition.

M. CLOGGED AIR FILTER SENSOR
Operates when the vacuum in the air intake system exceeds a preset value and makes the warning light come on.

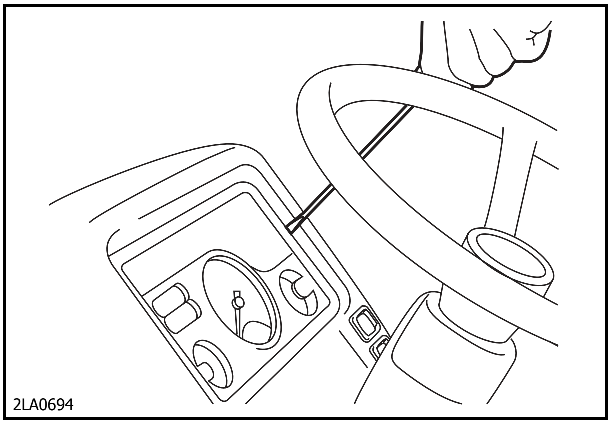
N. FRONT PTO SAFETY SWITCH.
Detects the position of the PTO in order to enable start-up when it is disengaged.

MAINTENANCE

Warning light replacement

Proceed in the following way to replace the indicator lights:

1. Use a screwdriver as a lever in order to remove the instrument from its housing.



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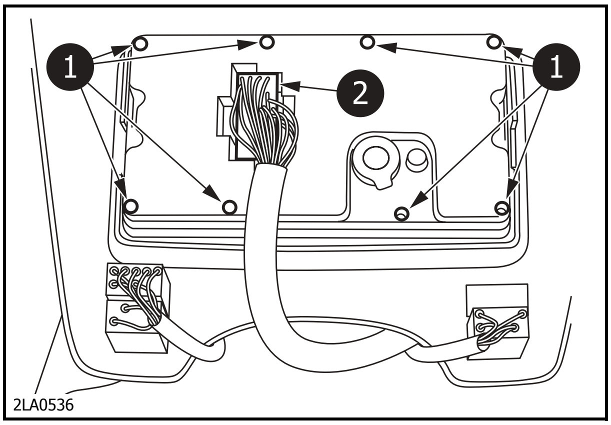
2. Remove the instrument from its housing and disconnect the connector (2).

3. Unscrew the screws (1) to remove the rear protection and access the indicator lights.



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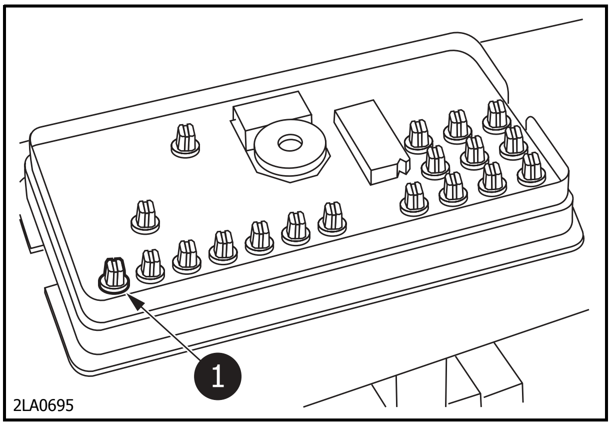
4. Turn the burnt-out indicator light (1) ¼ of a turn in the anti-clockwise direction, remove it and fit a new one with an equivalent power rating (1.2 W) in its place.



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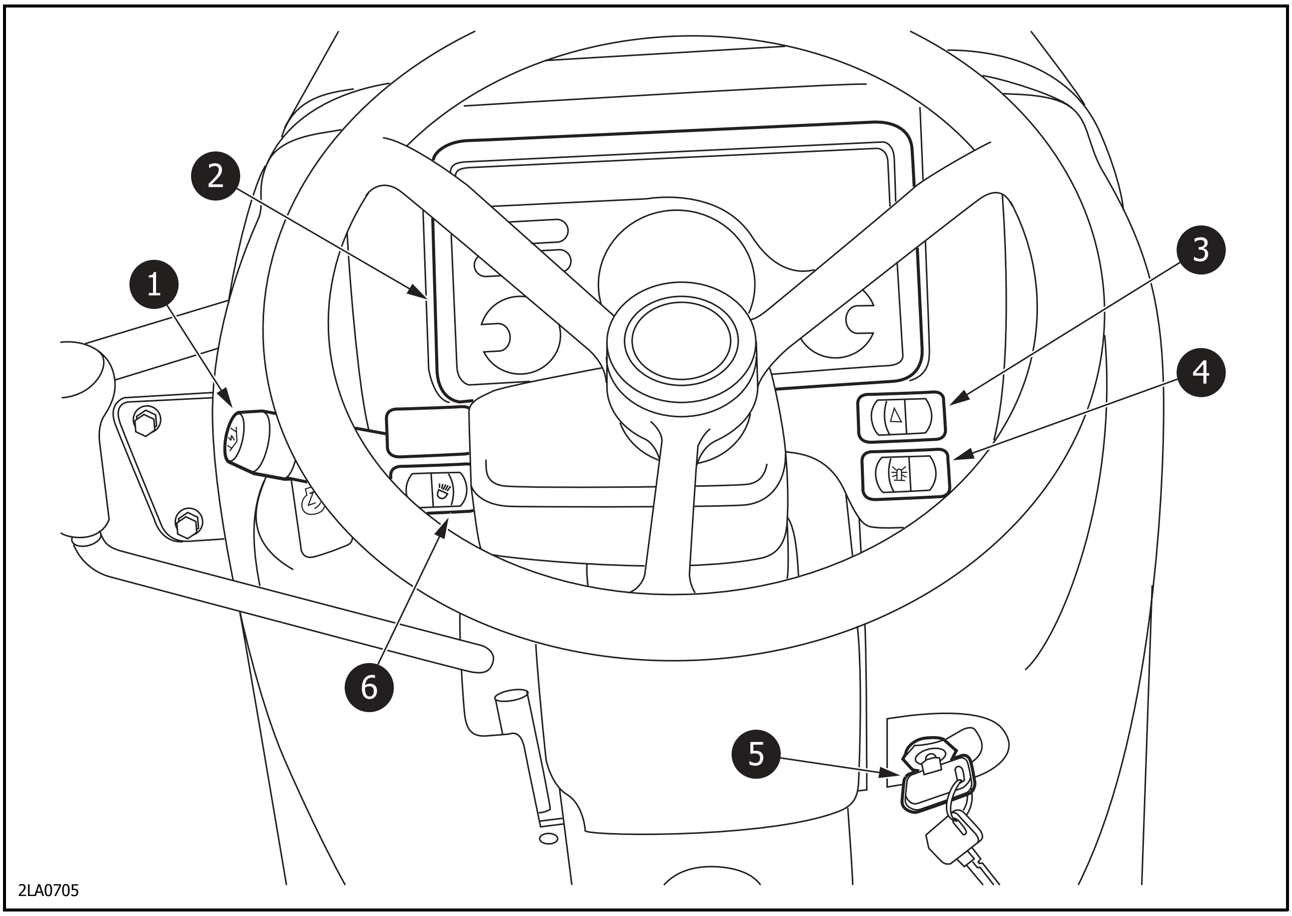
SECTION 1010

ELECTRICAL SYSTEM - COMPONENTS

INDEX

CONTROL PANEL WITH ANALOGUE INSTRUMENT

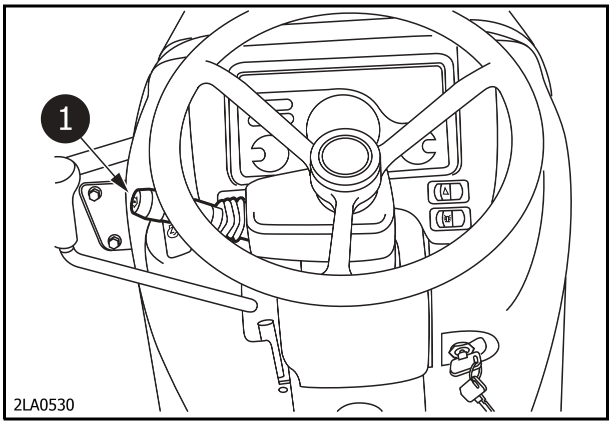


1

1. Light switches with incorporated turn indicators and horn.
2. Central instrument.
3. Hazard light switch
4. Rotating beam switch.
5. Ignition switch.
6. Field light control switch

LIGHT SWITCH

The light switch lever (1) is installed near the steering column and operates: the turn indicators; the blinking action with the driving beams; commutation of the side lights, dipped beams and driving beams; the horn.

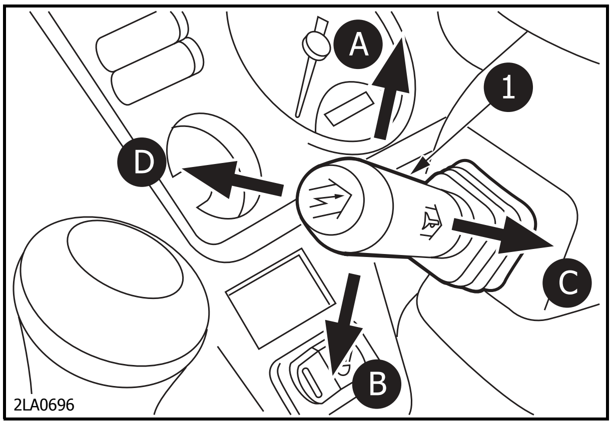


2

Turn indicators

To signal that you are about to turn to the left, pull the light switch lever (1) back to position (C).

To signal that you are about to turn to the right, push the lever forwards to position (D).



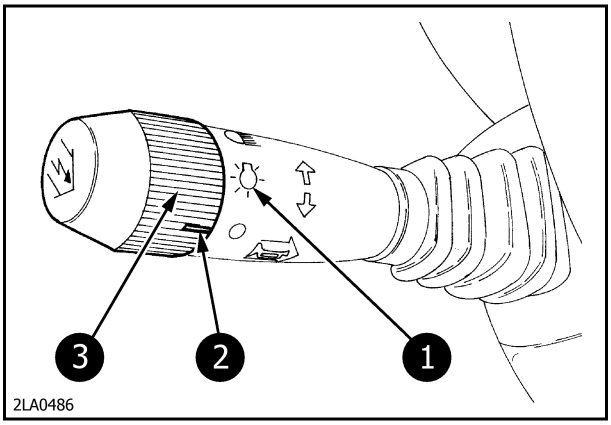
3

Driving beam blinking function

With the lights off or with the driving beams on, push the lever up to position (A, fig. 3) to blink the driving beams. The lever will automatically return to its original position when released.

Side lights

Turn the knob (3) and move the pointer (2) on a level with symbol (1). The side lights and control panel will light up.



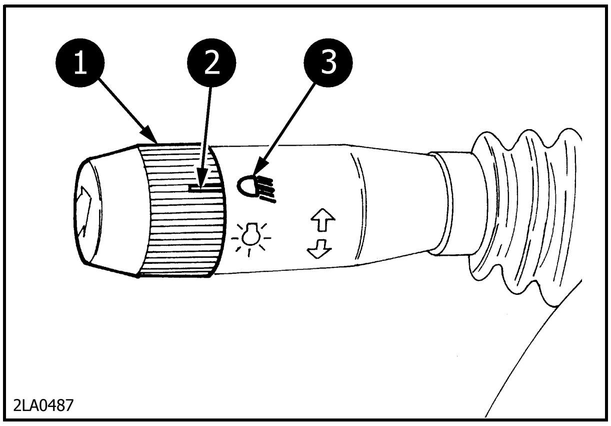
4

Driving/dipped beams

Move the pointer (2) of the knob (1) to symbol (3) to turn on the dipped beams or down to position (B, fig. 3) for the fixed driving beams.

Horn

Press the button at the end of the lever (1, fig. 3) to operate the horn.



5

HAZARD LIGHT SWITCH

Press the switch (3, fig. 1) to turn on the hazard lights. After the button has been pressed, the switch will flash along with the turn indicators.

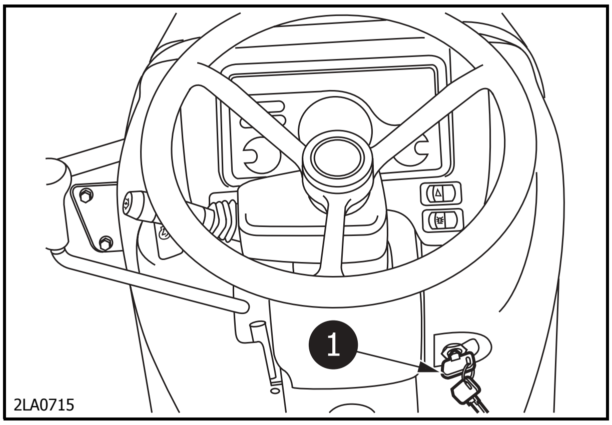
ROTATING BEAM SWITCH.

Press the switch (4, fig. 1) to operate the rotating beacon.

IGNITION SWITCH

Turn the key to the following positions to obtain the three ignition switch functions (1, fig. 6):

- position A = no circuit powered (the key can be removed). The engine stops.
- position B = presetting position for engine ignition. The indicator lights and monitoring instruments light up. Various users are powered.
- position C = the thermostarter warms up so that the engine can start in cold climates.
- position D = the engine starts: the key will automatically return to position (B) when released.



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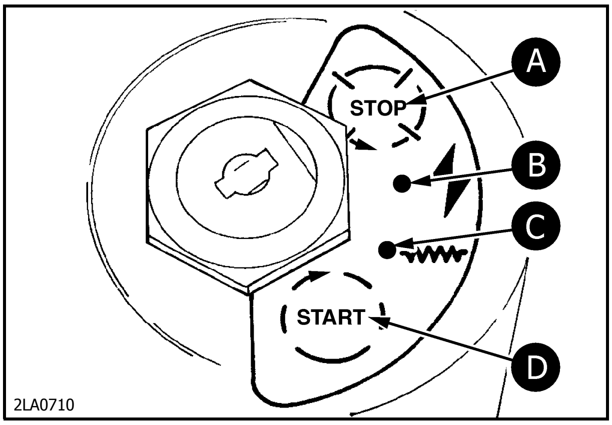


CONTROLS ON THE RIGHT-HAND SIDE

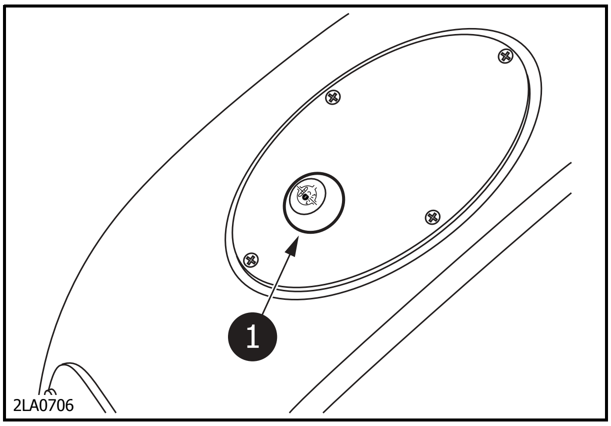
Diff lock control button

Press button (1) to lock the differential.

Locking is confirmed by the indicator light (15, fig. 2) described in section 1000, on page 4.

Depress one or both of the brake pedals to unlock the differential.

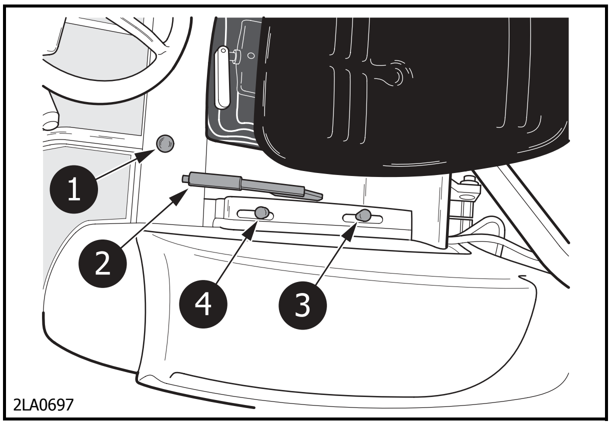
> To obtain the best result, the diff lock should be engaged before the wheels begin to slip. Do not engage the lock while a wheel is actually slipping.



7

CONTROLS ON THE LEFT-HAND SIDE

1. 4WD engaging lever.
   - Up – 4WD - ON
   - Down – 4WD - OFF
2. Hand brake lever
3. 540 RPM and 540E RPM PTO speed selector lever.
   - Up - 540 RPM
   - Centre - Neutral
   - Down - 540E RPM
4. Lever to engage the independent PTO or the PTO proportional to ground speed.



8

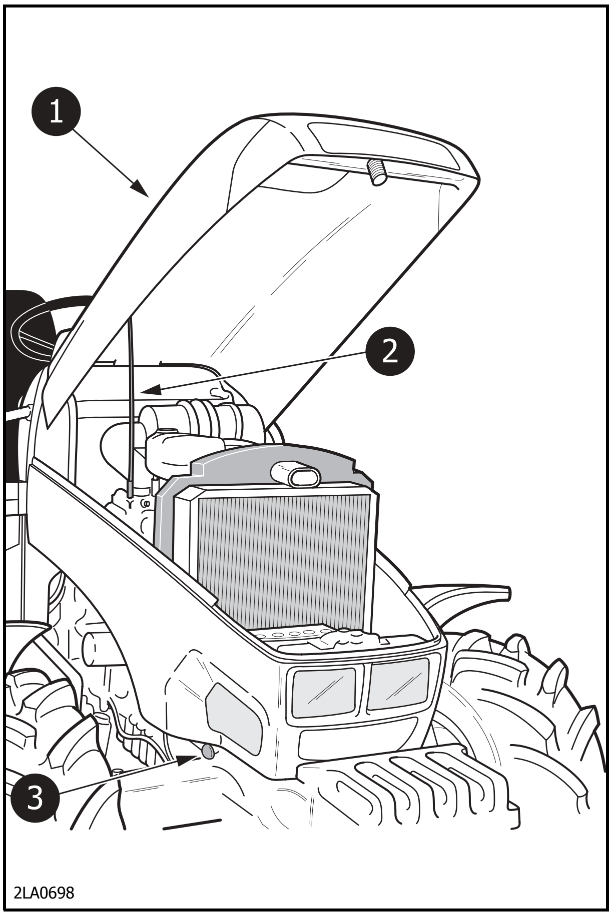
MAINTENANCE

Headlight bulbs. Replacement

> **CAUTION**
> Handle halogen bulbs by the metal part only. The light intensity of the bulb would be impaired if it were touched by the fingers and it would not last so long.
> If your fingers accidentally touch the bulbs, clean them with a cloth soaked in cleaning spirits and allow them to dry.

Proceed in the following way to replace the burnt-out bulbs:

- raise the bonnet (1).
  Pull down the red lever (3) on the right-hand side of the tractor, then position the metal rod (2) to support the bonnet itself;



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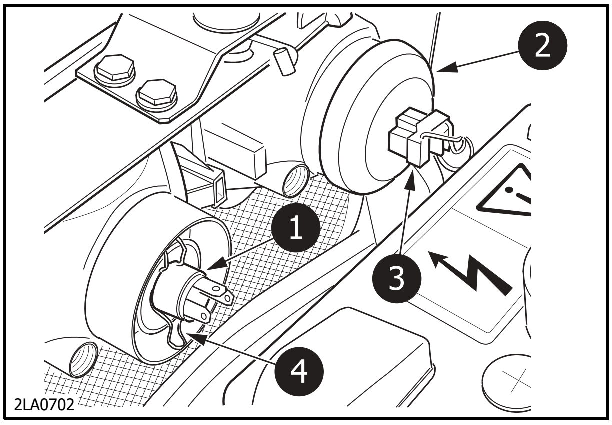
- detach the connection on the headlight (3);
- remove the rubber guard (2);
- release the spring that holds the light fitting (4) in place and remove the bulb (1);
- fit a new halogen bulb of the same power rating (55-60 W).



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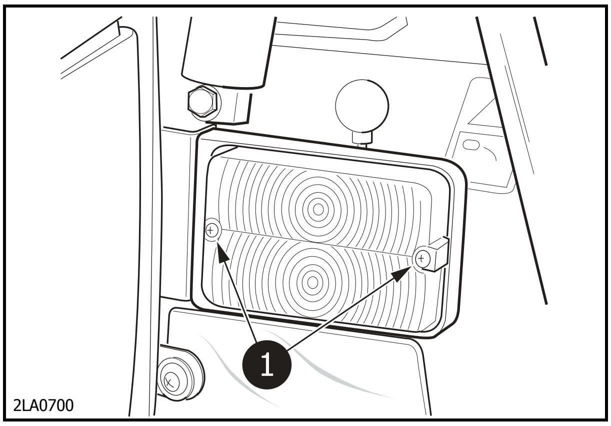
Bulbs in front side lights and turn indicators. Replacement

Remove the transparent cover after having unscrewed the two screws (1, fig. 11). Replace the burnt-out bulbs with others of the same power rating:

- turn indicator bulb (1) (21W): press the bulb inwards, turn it in the anti-clockwise direction and remove it;
- side light bulb (2) (5W): pull the bulb outwards and replace it.

The orange coloured transparent cover must be fitted back pointing upwards.



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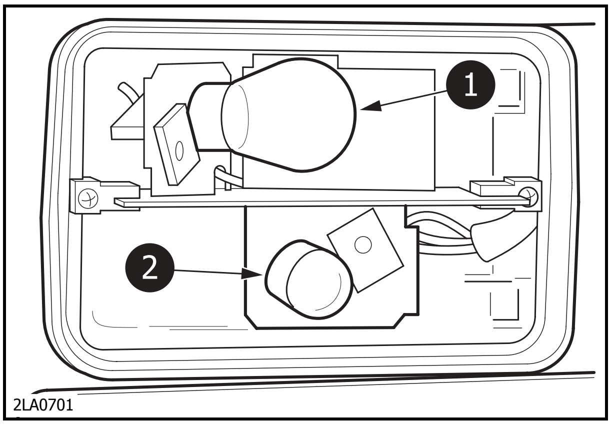
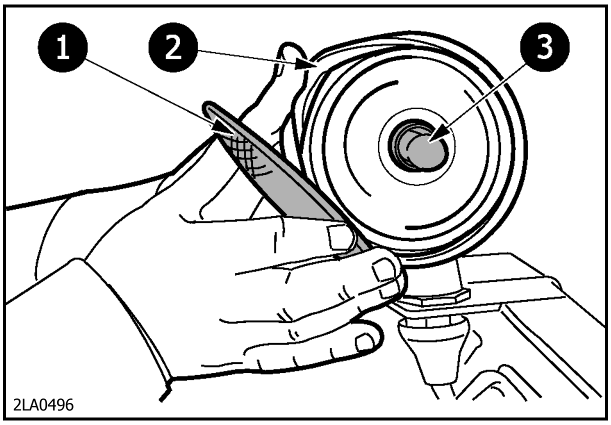


12

Rear field light bulb. Replacement

To access the bulb, overturn the rubber guard (2) and remove the transparent white cover (1).
Press the bulb (3) inwards, turn it in the anti-clockwise direction and remove it.
Replace the burnt-out bulb with another of an equal power rating (35 W).



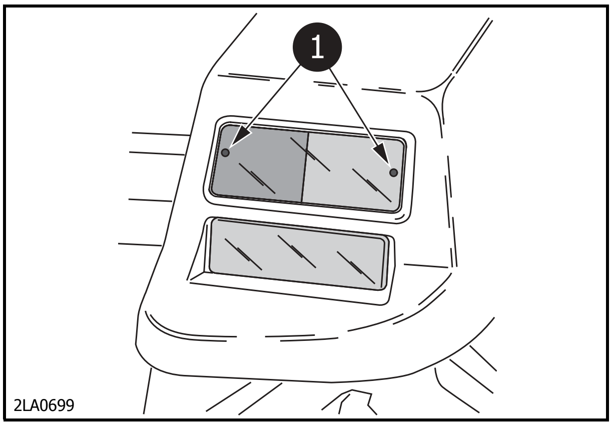
13

Bulbs in rear side lights, brake lights and turn indicators. Replacement

Remove the transparent cover from the light fitting by unscrewing the two screws (1). Now press the burnt-out bulb inwards, turn it in the anti-clockwise direction and remove it. Replace it with another of an equal power rating:

- turn indicator bulb (21W);
- double-filament brake lights and side lights 21W/5W.

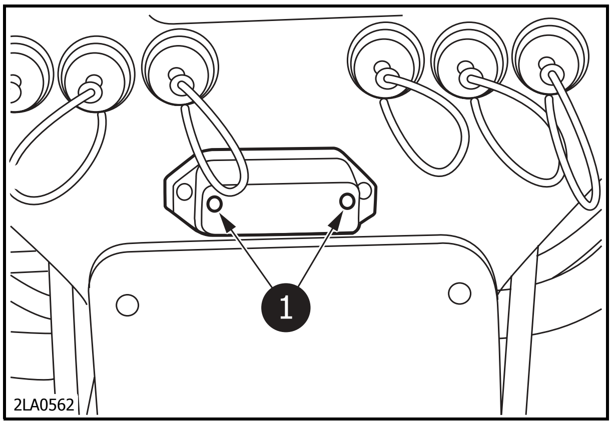
> The orange coloured transparent cover must be mounted towards the outer part of the mudguard.



14

License plate light bulb. Replacement

- Remove the cover by unscrewing the two screws (1) in order to access the bulb.
- Press the bulb inwards, turn it in the anti-clock-wise direction and remove it.
- Replace it with another of an equal power rat-ing (5W).



15

SECTION 1020

ELECTRICAL SYSTEM - IGNITION SYSTEM

INDEX

TECHNICAL SPECIFICATIONS

FEATURES	TYPE OF STARTER MOTOR
Starter motor	YANMAR
Power rating . . . . (kW)	1.2
Maximum power draw with no load (A)	60 at 11.7 V and 7000 RPM
Spinning direction (viewed from pinion side)	clockwise
Minimum diameter of commutator . . . . (mm)	45
Maximum armature shaft float . . . . (mm)	0.1 – 0.4

DESCRIPTION AND OPERATION

The type of ignition system depends on the type of gearbox mounted on the tractor. All systems include a key-switch, starter motor with electro-magnet, switches for the gearbox, reduction gear and on the PTO lever. These are components of the basic circuit used with mechanical gearboxes.

The standard starter motor with a 1.2 kW nominal power rating is the type with four poles and four brushes, built-in electromagnet and control unit with positive meshing.

The electromagnet contains two windings connected in parallel. One is the low resistance winding of the power coil, grounded by the engine, while the other is the high resistance winding of the retention coil, grounded by the body of the electromagnet.

When the key-switch makes contact, with the gearbox and reduction unit in neutral and the PTO lever in the disengaged position, the coils of the electromagnet are energized and the plunger is magnetically attracted inside the electromagnet. This movement, which is transmitted by means of a positionable articulation, forces the control pinion to mesh with the ring gear of the flywheel. The moment in which the pinion touches the ring gear, the plunger of the electromagnet makes a series of contacts to directly power all four coils from the battery, thus supplying full power to the starter motor.

At this point, one end of the power coil is connected to the battery positive by means of the ignition switch while the other end is connected to the positive by means of the solenoid valve contacts. This allows the power coil to be bypassed without power being drawn and the retention coil keeps the plunger of the electromagnet engaged on its own.

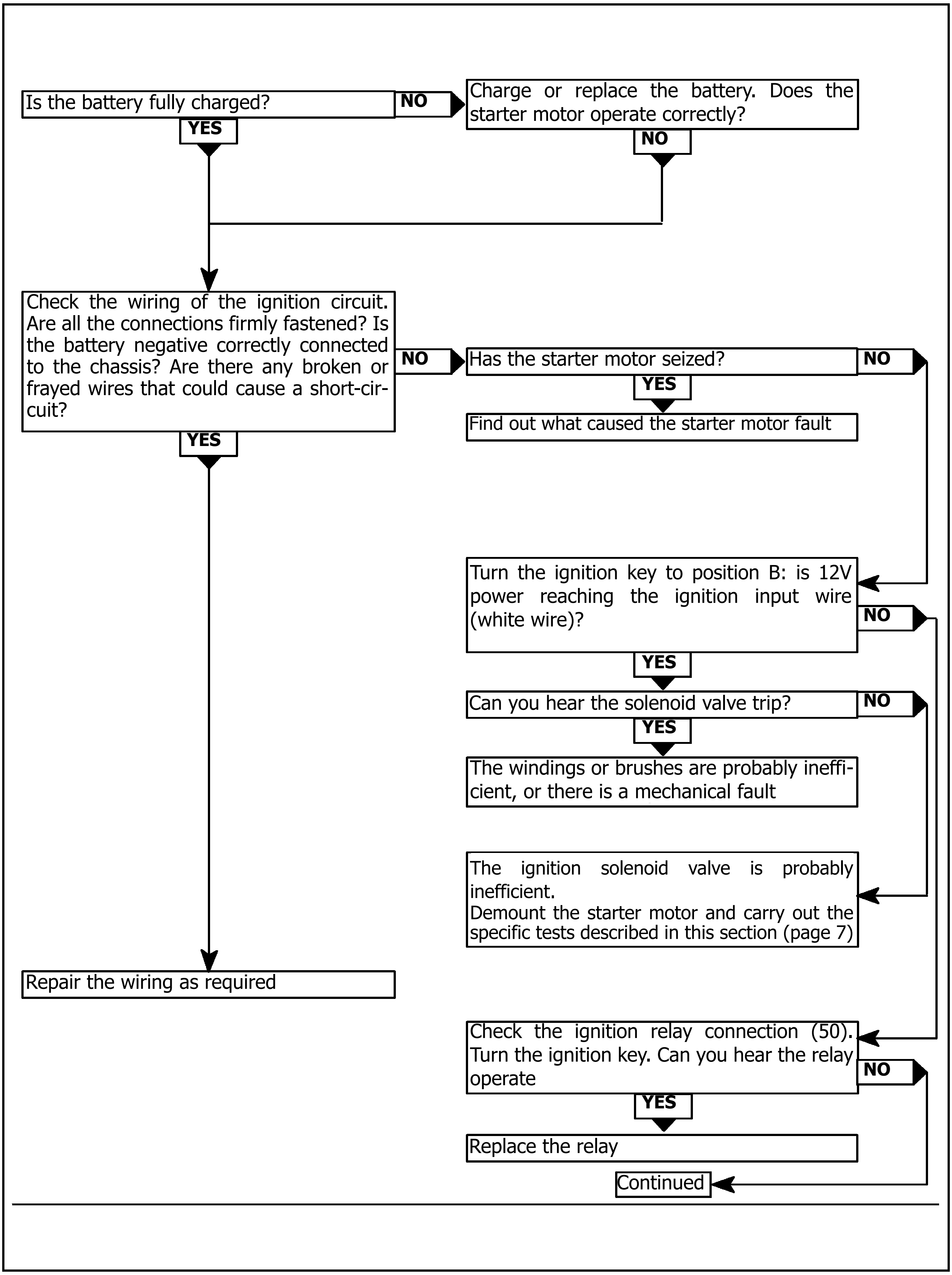
The starter motor contains a single set of contacts and a plunger of the electromagnet in two parts, which completely close the contacts even when the pinion teeth are not perfectly aligned with those of the ring gear. When this occurs, an engaging spring compresses and forces the pinion to fully mesh as soon as the starter motor starts to turn.

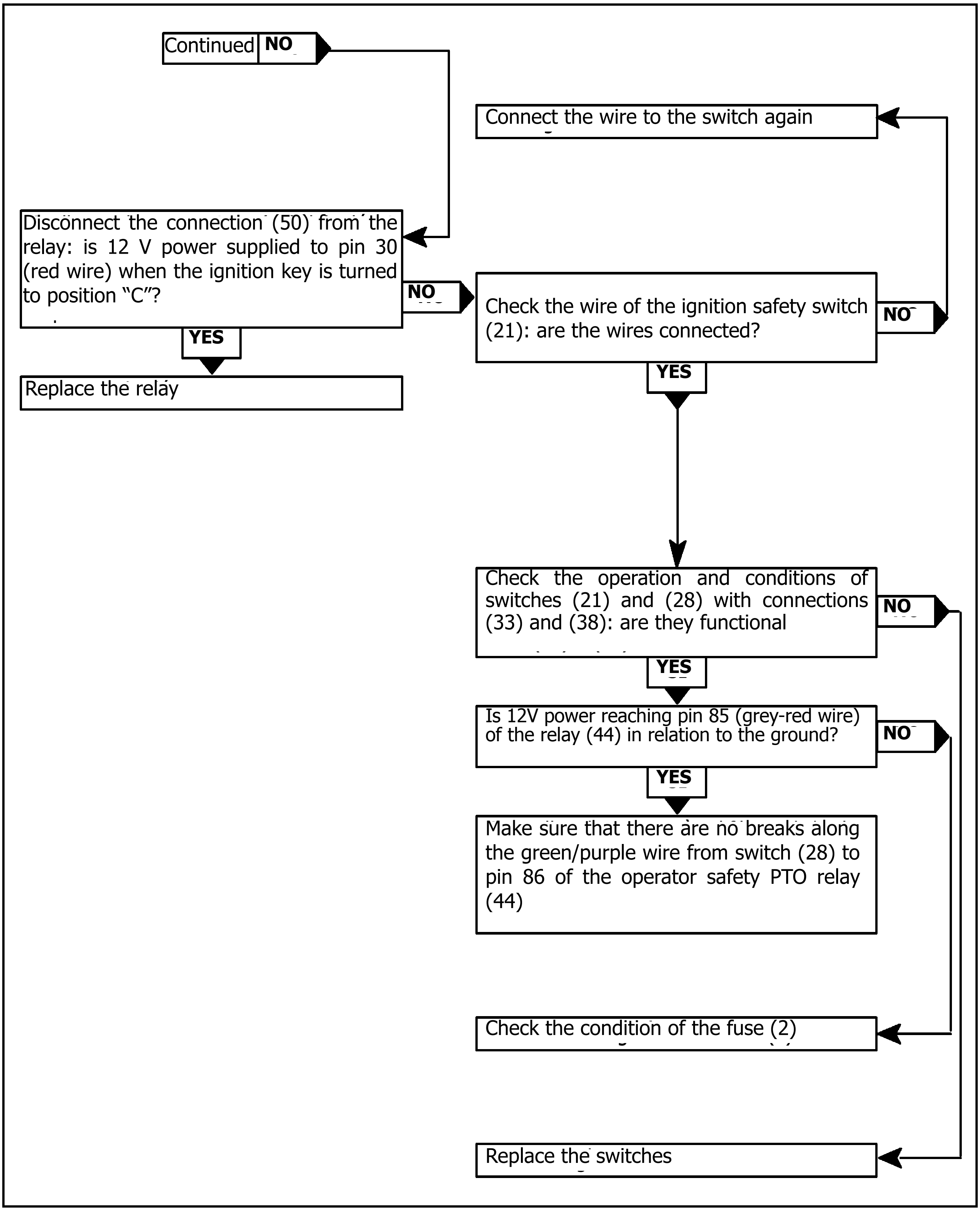
When the key switch is released, power is shut off both from the electromagnet and starter motor. By acting through the positionable articulation, the return spring of the electromagnet frees the control pinion from its meshed condition and re-opens the contacts of the solenoid valve.

The pinion unit includes a roller meshing device that prevents the armature from turning too much if the pinion remains meshed in the flywheel ring gear after the engine has started.

TROUBLESHOOTING

The engine fails to start when the ignition key is turned, gearbox and reduction gear in neutral and PTO lever in the disengaged position. Refer to diagram A on page 17 of section 1050.




Continued
NO
Connect the wire to the switch again
Disconnect the connection (50) from the relay: is 12 V power supplied to pin 30 (red wire) when the ignition key is turned to position “C”?
NO
Check the wire of the ignition safety switch (21): are the wires connected?
NO
YES
Replace the relay
YES
Check the operation and conditions of switches (21) and (28) with connections (33) and (38): are they functional
NO
YES
Is 12V power reaching pin 85 (grey-red wire) of the relay (44) in relation to the ground?
NO
YES
Make sure that there are no breaks along the green/purple wire from switch (28) to pin 86 of the operator safety PTO relay (44)
Check the condition of the fuse (2)
Replace the switches

TESTS

Ignition system test on the tractor

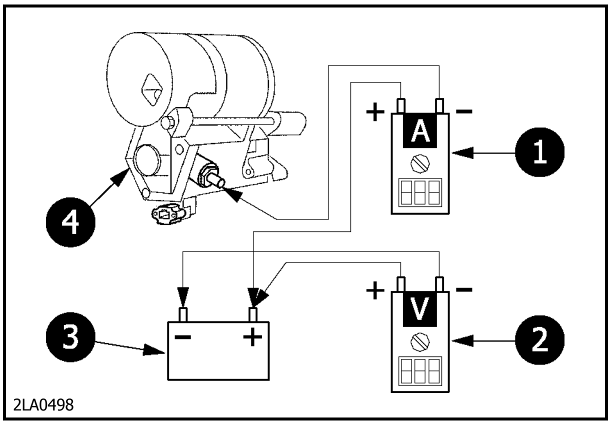
Use a battery/ignition tester (tester with a high discharge rate) with a 0-200V voltmeter and 0-500 A amperometer to quickly and easily identify faults in the ignition system and obtain conclusive results.

Comply with the test procedures recommended by the manufacturer when test equipment is used. If test equipment is not available, use the following test procedure with a normal 0-20 V voltmeter and 0-500 A amperometer to check that the starter motor operates correctly without removing it from the engine.

Prior to the test:

- Make sure that the battery is fully charged
- Make sure that none of the ignition system wires is broken or frayed and that none of the connections is slack.
- Make sure that the engine is not seized.

Power draw in the starter motor circuit



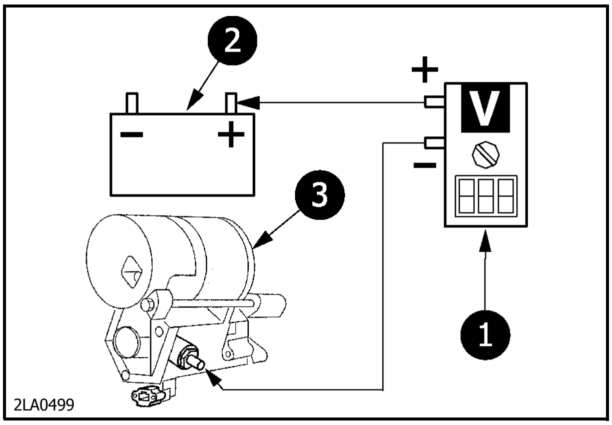
1

1. Disconnect the ground wire (negative) from the battery (3).
2. Disconnect the positive wire of the battery from the starter motor (4). Connect the positive prod of an amperometer (1) to the positive battery terminal and the negative prod to the power terminal.
3. Re-connect the ground wire (negative) to the negative terminal of the (3).
4. Connect the positive prod of a voltmeter (2) to the positive battery terminal and the negative prod to the negative terminal of the battery.
5. Disconnect the wire from the closing solenoid valve of the injection pump.
6. Allow the engine to operate and check the readings on the voltmeter and amperometer. The voltage must remain constantly at around 12 V with a 250-300 A power draw.
   - If the power draw corresponds to the technical value, this means that the starter motor (4) operates correctly. If the voltage drops during the test, comply with the procedure described in the “Resistance in the ignition circuit” section.

- If the power draw is higher than the technical value, check the circuit as described below. If the ignition circuit tests are satisfactory, the starter motor is defective and must be demounted in order to identify the cause.
- If the power draw corresponds is less than the technical value, this means that the starter motor must be demounted in order to identify the cause.

Resistance in the ignition system circuit (voltage drop)

If the power draw is excessive, check the circuit to find out what is causing the voltage drop between the individual components of the circuit itself.



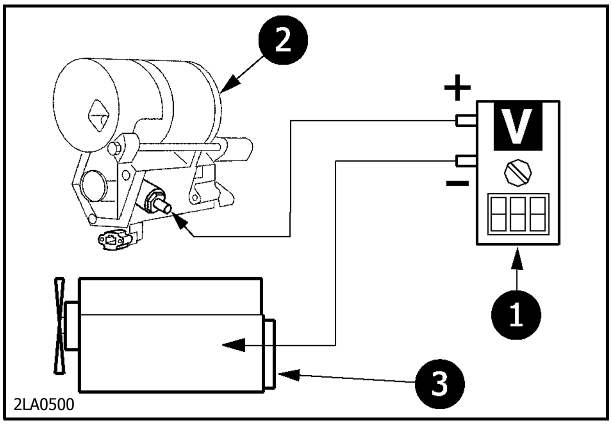
2

Positive battery cable

1. Connect the positive prod of the voltmeter (1) to the positive terminal of the battery (2).
2. Connect the negative prod of the voltmeter to the power terminal of the starter motor (3).
3. Allow the engine to operate and check the reading on the voltmeter. If the voltage exceeds 0.2 Volts, check and tighten the cable connections. Check the voltage again and install a new cable if it is too high.

Ground connection of the starter motor

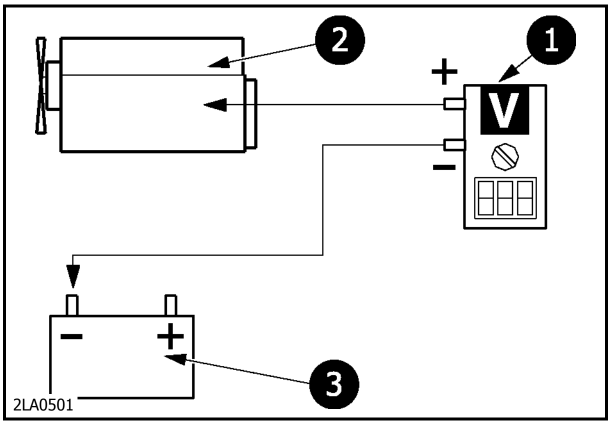
1. Connect the positive prod of the voltmeter (1) to the casing of the starter motor (2).
2. Connect the negative prod of the voltmeter to the engine block (3).
3. Allow the engine to operate and check the reading on the voltmeter. If it is higher than 0.2 V, check the ground connections between the flange of the starter motor and the rear engine cover.



3

Battery ground cable

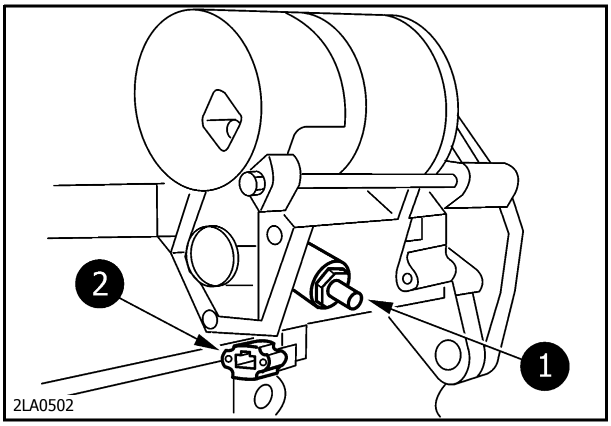
1. Connect the positive prod of the voltmeter (1) to the engine block (2).
2. Connect the negative prod of the voltmeter to the negative terminal of the battery (3).
3. Allow the engine to operate and check the reading on the voltmeter. If the voltage exceeds 0.2 Volts, check and tighten the ground cable connections. Check the voltage again and install a new ground cable if it is still too high.



4

STARTER MOTOR. SPLITTING-REMOUNTING

1. Disconnect the negative wire from the battery.
2. Unscrew the nut and remove the power supply terminal (1, fig. 5).
3. Disconnect the green coloured unipolar connection (2).



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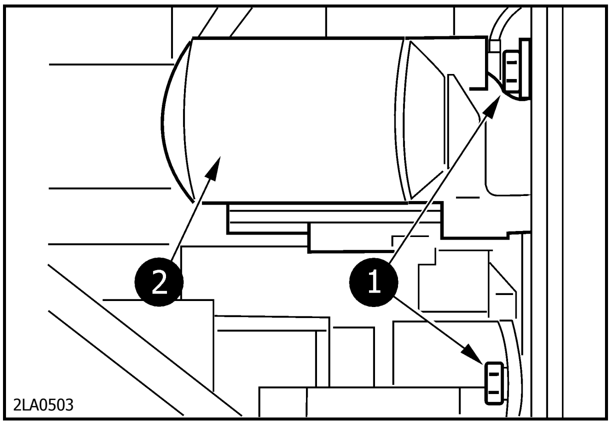
4. Remove the two fixing bolts (1, fig. 6) of the starter motor (2) and remove it.
5. Work through the splitting operations in reverse order to remount the starter motor.



6

SECTION 1030

ELECTRICAL SYSTEM - RECHARGING SYSTEM

INDEX

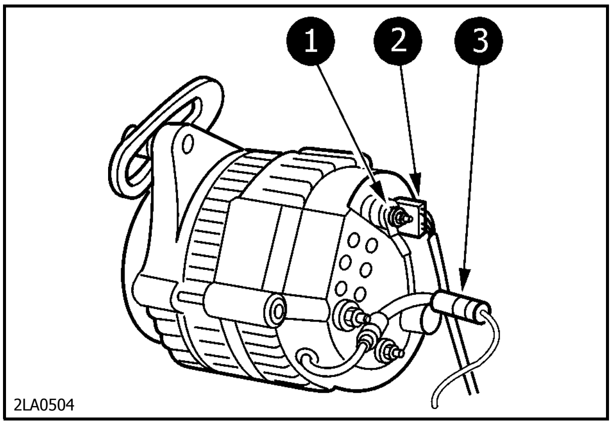
TECHNICAL SPECIFICATIONS

FEATURES	TYPE OF ALTERNATOR HITACHI LR140-714B
Polarity	Negative ground
Spinning direction (viewed from pulley side)	Clockwise
Voltage rating (V)	14
Maximum rotation rate (RPM)	10,000
Maximum output (A)	40A
Voltage monitored by governor (V)	13.6 - 14
Inductor winding resistance (Ω) at 25°C	3.0 – 3.2
Voltage governor	Built-in

DESCRIPTION AND OPERATION

Description of the alternator

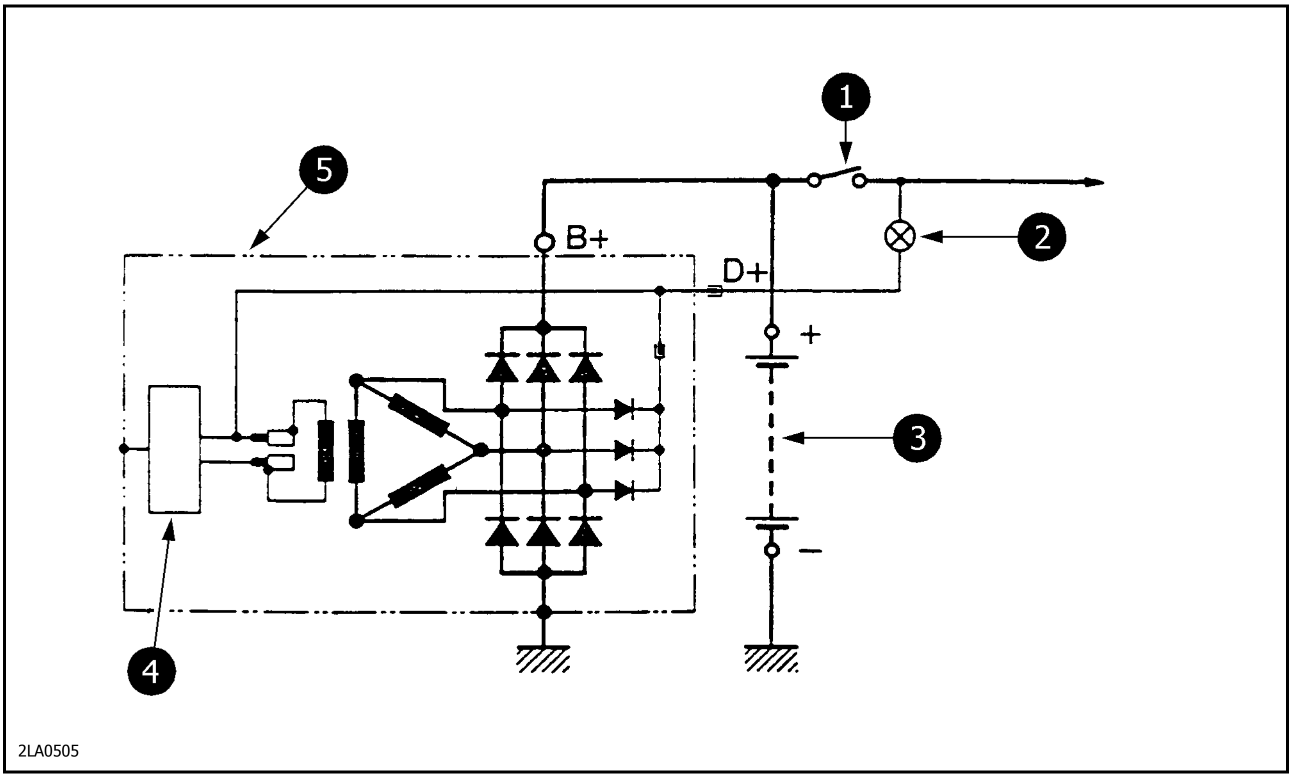
All models are fitted with the 40 A alternators of the Hitachi type, with internal cooling fan. The stator winding is ventilated by means of an air conveying diaphragm in the support on the rectifier link side and with peripheral openings around the support on the control side. The alternator is installed on the left-hand side of the engine and is operated by a pulley via a V-belt. The alternators are equipped with a built-in governor.



1

40 A alternator

1. Battery connection (terminal B+)
2. Battery recharge indicator light connection
3. Speed indicator signal connection



2

Alternator charging circuit

1. Ignition switch
2. Alternator charge indicator light
3. Battery
4. Electronic voltage governor circuit of the alternator
5. Alternator
B+ :Battery connection
D+ :Alternator charge indicator

Alternator operation

A current passes from the battery through the field winding of the rotor when the ignition key is turned. The circuit closes between the light that indicates the charge, terminal D+ of the alternator, the rotor's field winding, the alternator governor and ground.

At this point, the indicator light comes on and the rotor is partially magnetized.

Threephase alternate current is generated when the engine starts and the partially magnetized rotor turns inside the stator windings. A constant quantity of that current is converted into direct current by the three field diodes built into the rectifier unit.

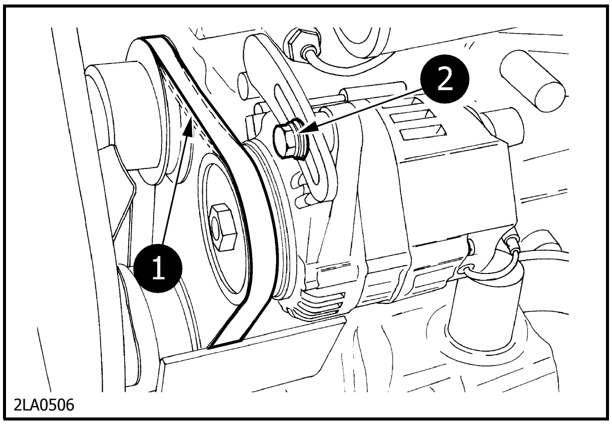
The direct current is then conveyed around the circuit again to increase the current that flows through the field winding of the rotor.

This action leads to a continuous increase in the rotor's magnetic field plus a rapid increase in current production.

The luminosity of the indicator light diminishes during the voltage increase generated on the output (which reflects on terminal D+) and when the voltage on terminal D+ is the same as that on the battery side, the indicator light goes out.

The voltage continues to increase until it reaches the preset regulated voltage level.

The alternator will be unable to operate if the control belt breaks, thus the charge indicator will remain on to warn of the fault.



3

Fan belt tightener

1. Belt
2. Belt tightener nut

TESTS AND TROUBLESHOOTING

Precautions to take during the operation

Take the following precautions to prevent the components of the alternator charging system from being damaged:

- **NEVER EVER MAKE OR BREAK** any connection in the charging circuit, including the battery, when the engine is running.
- **NEVER EVER SHORT-CIRCUIT** the positive terminal of the alternator to check whether this latter is working.
- **ALWAYS DISCONNECT** the battery cables when the battery is recharged on the tractor with a battery charger.
- **ALWAYS COMPLY WITH** the correct polarity when the battery is installed or when an auxiliary battery is used to start the engine.
- **DO NOT SHORT-CIRCUIT** the input and output terminals of the voltage governor when the alternator is operating.

Preliminary inspections

Before proceeding with the electrical tests, carefully inspect the charging system and electrical system in general.

Make sure that none of the conductors or connections is broken and check that they are all firmly fastened.

1. Battery inspection

Check all the battery components with a densimeter. The battery must be charged to at least 70% of its capacity and be efficient (see section 1040, page 5).

2. Control belt inspection

Inspect the pulley and alternator belt to make sure that they are clean, with no traces of oil or grease and that they are in a good condition.

Periodically check the tension of the alternator belt. If you think that the belt is not taut enough, check the tightener as indicated below, with reference to fig. 3:

- loosen the alternator fixing nut (2) on the tightener bracket.
- using a lever, move the alternator along the tightener bracket until the correct belt (1) tension is obtained (10-11 mm), then re-tighten the fixing nut (2).

> The belt must be replaced if it is cracked or needs adjusting too frequently.

3. Indicator light inspection

Turn the ignition key and make sure that the indicator light comes fully on.

If the bulb is not burnt out, test the connections of the alternator winding as described in the “INITIAL TESTS” chapter of this section.

If the indicator light is on, start the engine and allow it to run at a higher rate than idling. The indicator light must go out.

If it fails to go out, stop the engine and remove the wire from terminal D+. If the light now goes out, it means that one of the alternator components is defective.

Initial tests

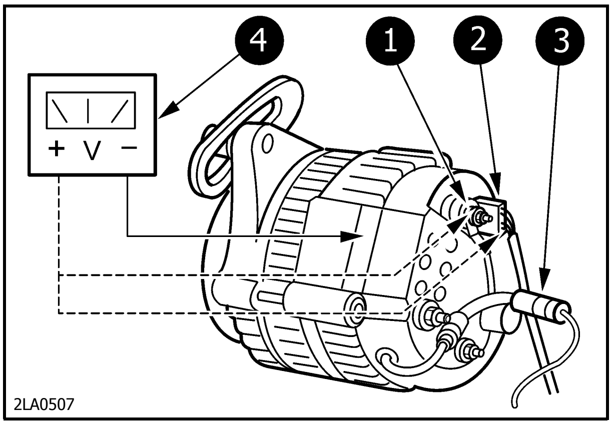
The initial tests can be conducted without removing any of the charging circuit components from the tractor. They allow you to check:

- the condition of the alternator wire connections
- the alternator charge current and controlled voltage
- the voltage drops in the charging circuit of the alternator
- the maximum output of the alternator
- Test equipment required:
- 0 to 30 V voltmeter with mobile coil
- 0 to 1 V millivoltmeter
- 0 to 110 A amperometer with mobile coil
- 1.5 Ohm 110 A variable load resistance.

Alternator connection test

1. Disconnect the battery.
2. Disconnect terminals B+ (2) and D+ (3) from the alternator.
3. Re-connect the battery and turn the ignition key to the ON position but without starting the engine. Connect a voltmeter (4) between each terminal and ground. The battery must be powered.

   If there is no voltage, identify and repair a continuity fault in the external cable circuit. Refer to the wiring diagram A in figure 2.



4

4. Ground terminal D+ of the indicator light. The indicator light must come on.
5. Disconnect the battery and re-connect the previously disconnected connectors to the alternator.

> If the indicator light fails to come on when the wire is re-connected to the alternator, this means that there is a fault in the alternator's governor circuit or in that of the rotor. Make sure that terminal D+ is clean and then test the alternator components as described in this section.

Charge current and regulated voltage tests

Make sure that all the tractor's electrical users are off and that the ignition key is in the OFF position.

6. Disconnect negative battery terminal and terminal B+ (3) of the alternator.

7. Connect an amperometer (1) between the detached cable (4) and terminal B+ of the alternator.

8. Connect a voltmeter (2) between terminal B+ of the alternator and ground.

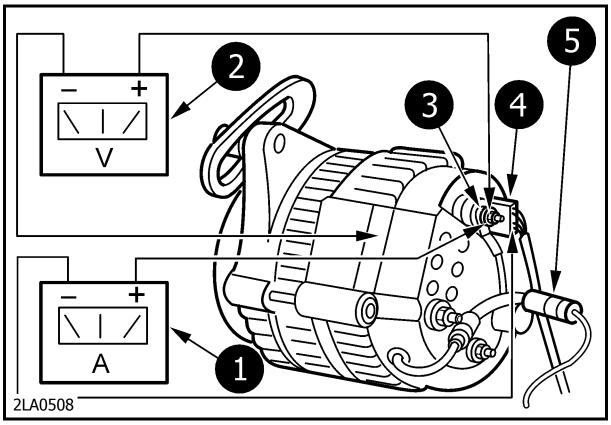
9. Re-connect the battery. Start the engine and accelerate to 2000 RPM. Check the voltmeter and amperometer readings.

The voltmeter must give a higher value than the battery voltage and, when the amperometer reading drops below 10 A, the voltmeter reading must stabilize between 13.6 and 14 V.

10. Slowly increase the current charge (lowering the value of the resistance) until the amperometer reading becomes 40 A.

11. Check the voltmeter reading, which must not drop below 13.6 V.

A reading of less than 13.6 means that there is a defective component in the alternator. Test the alternator components as described in this chapter.



5

Alternator component tests

The component tests, which must only be carried out if the INITIAL TESTS have identified a defective component in the alternator, allow you to check:

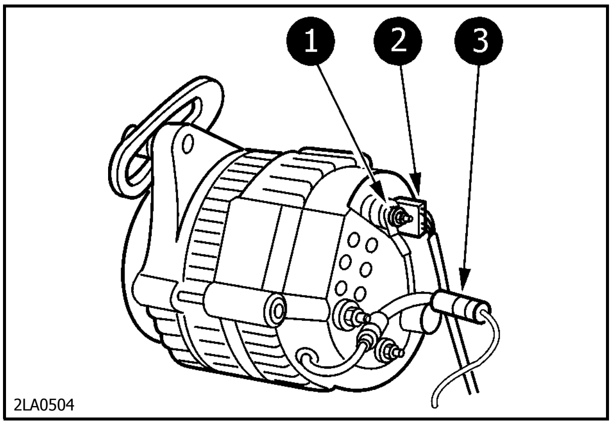
- the governor;
- the no-break condition of the rotor field windings;
- the brushes, springs and contact rings of the rotor.

> The previously described component tests can be conducted with the alternator installed in the tractor. To test the other components, the alternator must be removed from the tractor.

ALTERNATOR. SPLITTING-REMOUNTING

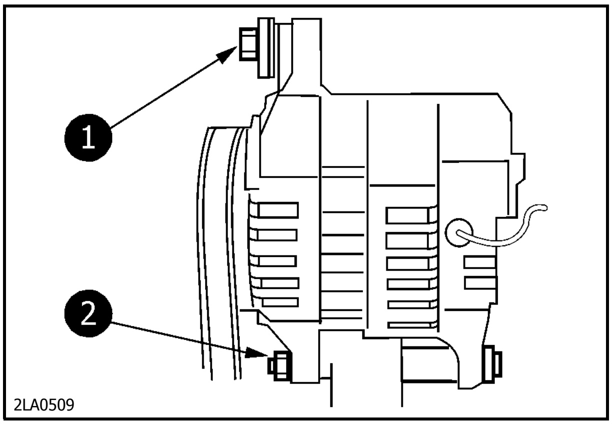
> ☞ Make sure that the ignition key is in the OFF position before disconnecting the alternator wires.

1. Raise the bonnet.
2. Disconnect the two wires B+ (1), connection (2) and the unipolar connection (3).



6

3. Loosen and remove the nut and bolt (1, fig. 7) that fix the alternator to the belt tightener.
4. Move the alternator in order to slacken the belt, thus removing it from the pulley.
5. Remove the nut (2), fig. 7) from the through bolt that fixes the alternator to the engine.



7

SECTION 1040

ELECTRICAL SYSTEM - BATTERY

INDEX

TECHNICAL SPECIFICATIONS

FEATURES	TYPE OF BATTERY
Voltage (V)	12
Cold starting current (C.C.A)	6800
Capacity (Ah)	60
Number of elements	6
Weight (kg)	~ 20
Ground terminal	Negative

DESCRIPTION AND OPERATION

The battery is the maintenance-free “sealed” type. It is installed as standard supply in all models and is positioned in front of the engine.

> ☞ “Maintenance-free” means that the battery does not lose water from the electrolyte during normal charging conditions. The conditions that could lead to water leaks include charges prolonged beyond 14.4 V where gassing occurs as the battery fully charges. This can be caused by a defective charging system, by quick-charging equipment, etc.

The three main functions of the battery are:

- To provide a source of electric current for starting, ignition and the instruments.
- To monitor the voltage of the electrical system.
- To supply electric current when the power draws exceed the energy provided by the alternator.

The battery is made so that each element contains positive and negative plates arranged alternately, one alongside the other. Each positive plate is separated from the negative plate by a separator with a porous and insulating casing. If one of the positive plates comes into contact with the negative plates in an element, this latter will short-circuit and be subjected to irreparable damage. All the positive plates are welded to a collector bar and form a positive terminal. All the negative plates are welded to a similar collector bar and form a negative terminal.

Each positive plate consists of a lead grid with led peroxide plugged in the grid openings. The negative plates consist of a lead grid with spongy lead plugged in the grid openings.

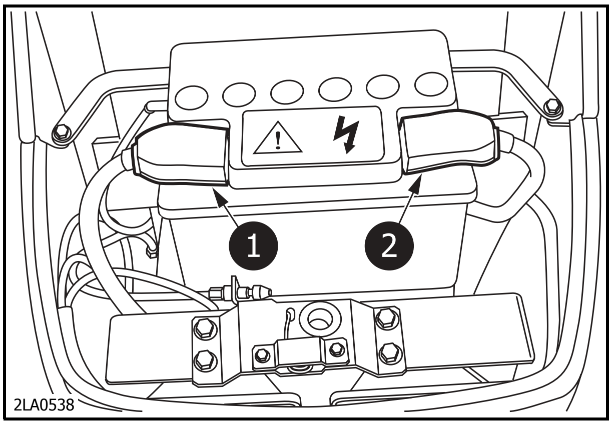
The plates are immersed in electrolyte formed by a solution of diluted sulphuric acid.

The battery case is made of polypropylene.

BATTERY SPLITTING-REMOUNTING

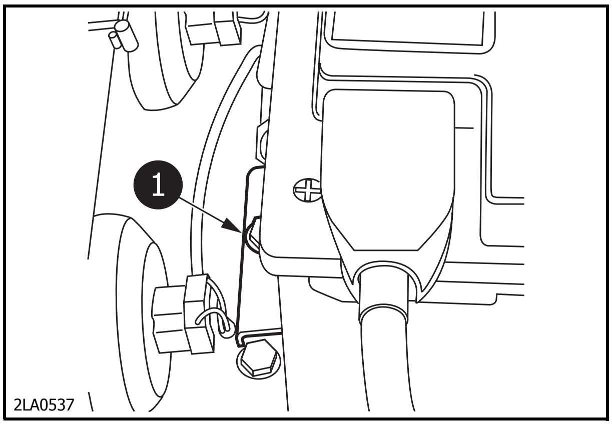
Splitting

1. Raise the bonnet.
2. Loosen the bolts of both terminals and disconnect the negative and (2) positive cables (1) from the battery. Make sure that they do not touch the battery itself.



1

3. Loosen the battery fixing bolt (1) on the front part.



2

Remounting

Work through the demounting procedure in reverse order when remounting the battery, and take the following precautions:

- Make sure that the battery is clean and that there are no traces of spilt electrolyte on the outside. Make sure that the vents are completely installed. Smear Vaseline or similar on the terminals. Do not use conventional lubricating grease as this could cause electrolytic corrosion.
- Make sure that the battery housing or supports and the terminals are clean, with no stones or small objects that could perforate the battery case.
- Make sure that the polarity of the battery terminals is correct and that the terminal connections are firmly fastened.

MAINTENANCE AND BATTERY INSPECTION

Specific gravity

The specific gravity of the battery acid indicates the charge status. When the battery is fully charged, the specific gravity of the electrolyte is at least 1.280 at 25°C.

Alternatively, the approximate charge status can be measured with a digital voltmeter
(± 0.01V) in the following way:

Less than 10.5 V Unserviceable battery*
Less than 11.8 V Battery discharged
Less than 12.3 V Battery half charged
More than 12.6 V Battery fully charged

* Consult the notes in chapter “TESTS” for instructions about how to recover a slightly sulphated battery.

The battery voltage must be measured with the battery discharged and:

A. After the battery has been discharged for at least 4 hours.

B. Turn on the headlights for 2 minutes if the tractor has been used recently or if the battery has been charged recently.

When a battery is discharged, the sulphuric acid in the electrolyte combines chemically with the plates and this action causes the specific gravity of the solution to diminish.

A battery densimeter will determine the specific gravity of the electrolyte in an element and the quantity of unused sulphuric acid in the solution will indicate the charge degree of that element.

The lower the temperature at which the battery must operate, the more the battery must be kept in fully charged conditions. For example, a battery with a specific gravity of 1.225 at 27°C (80°F) will operate the starter motor at mild ambient temperatures, but may not do this at low temperatures owing to inferior battery efficiency.

Table 1 illustrates the effect of the temperature on battery efficiency.

Table 1

Temperature	Efficiency of a fully charged battery
25.0°C	100%
-4.5°C	82%
-24.0°C	64%
-27.5°C	58%
-31.0°C	50%
-34.5°C	40%
-37.5°C	33%

Maximum battery life can be obtained by paying the necessary attention and making periodical inspections. The capacity delivered must not be exceeded by constant and excessive overcharging and the charging requisites must be maintained.

Maintenance

> **DANGER**
>
> Batteries contain sulphuric acid. When they are charged they generate a highly explosive mixture of hydrogen and oxygen gas.

- Never use tools that produce flames or sparks to check the level of the battery acid.
- Never remove the caps from the battery without protecting your eyes and hands.

Take the following steps during battery maintenance:

1. Keep the electrolyte at the recommended level, i.e. 17 mm above the plates. Failing this, the acid will reach a high concentration that could damage the separators and impair the efficiency of the plates.
2. Use only distilled or demineralized water. Do not overfill and do not use tap water, rain water or water from other sources to top up the battery acid.
3. Always keep the battery at least 75% charged, otherwise the plates will become sulphated.This will lead to a drop in efficiency with possible damage from freezing at low temperatures.
4. Do not overcharge the battery as this can lead to excessive internal heat which damages the plate grid and leaks to water leaks.
5. During rapid charges, make sure that the temperature of the battery does not exceed 50°C.
6. Do not add sulphuric acid to an element unless the battery acid has been lost through leaking. Before filling, make sure that the specific gravity of the solution is correct. Slow charging is the only method to use if the battery is to be fully charged. A high current battery charger can be used to charge the battery quickly, but this latter must subsequently be slowly charged in order to ensure full charging.

Batteries charged dry

Dry charged batteries must be prepared for use in the following way:

1. Remove the vent plugs from the battery element.
2. Fill each element to the recommended level using electrolyte with a 1.260 specific gravity.

> ☞ The electrolyte must consist of diluted sulphuric acid at the preferable temperature of 21°-32° C.

3. After it has been filled, allow the battery to rest for 15 minutes, then check the level of the electrolyte again and top up if necessary.
4. Charge the battery for 4 hours with a 5-8 A current rating and make sure that all the elements freely develop gas.
5. Fit the vent plugs of the battery element back in place.

Battery charging

Before charging a battery:

1. Thoroughly clean the battery case and the covers of the elements with diluted ammonia or hot water, and clean the terminals.
2. Check the level of the electrolyte in each element and, if it is below the plates, add distilled water to bring it above plate level.

Normal charge

1. With a slow battery charger, use a 3 to 6 A current for the time required to fully charge the battery. This operation could last 36 hours or more if the battery charge is very low. A seriously sulphated battery may not charge. When the battery is fully charged, the elements will freely develop gas and the specific gravity will remain constant. Disconnect the battery charger after three consecutive readings of the densimeter made each hour, that indicate that the specific gravity has stopped rising.
2. High charging current raises the temperature of the electrolyte and, unless the battery charger has an automatic timing or temperature device, the temperature of the electrolyte could exceed 50°C. This could lead to violent gassing and damage the internal battery components.
3. Check the level of the electrolyte in each element again, and add distilled water if necessary.

DANGER

An explosive gas is produced when a battery is charged. Do not smoke or use naked flames when checking the level of the electrolyte and make sure that the battery charger is off before connecting or disconnecting, in order to prevent the formation of sparks which could ignite the gas.

Charging very discharged batteries

The best way to charge a maintenance-free Pb-Ca battery is to use a constant voltage battery charger. For very low batteries, it is advisable to charge for 48 hours at 16 Volts with current limitation (30A per 60Ah).

This system is self-regulating: a high current is supplied at the beginning (when the battery voltage is very low), while an increasingly lower current is then absorbed when the battery is fully charged (and its voltage is high).

If only constant voltage battery chargers are available, it is advisable to comply with the voltage levels and time settings given in Table 2. The figures refer to batteries with very low charges. If the battery is only half discharged, allow half the time indicated (slow charging methods). Proportionally reduce the charging time for other conditions of discharge. When possible, use the slower recharging method to increase battery life.

Table 2

	Type of battery
	60Ah
Slow charging methods	25 hours at 5A 12.5 hours at 10A
Quick charging methods (only for emergencies)	7 hours at 10A

If violent gassing occurs, the electrolyte overflows when the battery is being charged, or the battery case becomes hot (50°C or more), reduce or stop charging temporarily in order to prevent the battery from being damaged.

Tests

Before beginning the tests, check the battery to make sure that none of the vents is clogged, that there is no rust, raised vent caps and that the case is not cracked.

Equipment required for the tests:

- Densimeter
- Battery starter tester (high current discharge tester)
- Thermometer
- Battery charger

Specific gravity This test establishes the battery charge status.

1. Take a reading with the float in the vertical position.

2. Adjust the reading of the densimeter for the temperature variations of the electrolyte by subtracting 4 points (specific gravity 0.004) for every 5.5°C below the temperature for which the densimeter is calibrated and by adding 4 points (specific gravity 0.004) for every 5.5°C above this temperature.

The following examples have been calculated using a densimeter with a 30°C setting.

Example 1:
Temperature less than 30°C
Electrolyte temperature 19°C
Densimeter reading 1.270
Subtract $\frac{11.0}{5.5} \times 0.004$
Correct specific gravity = 1.262

Example 2:
Temperature more than 30°C
Electrolyte temperature 40°C
Densimeter reading 1.220
Add $\frac{10.0}{5.5} \times 0.004$ 0.007
Correct specific gravity = 1.227

3. Use the following table to establish the charging condition.

Charging condition	Specific gravity (correct) at 15°C	Specific gravity (correct) at 25°C	Average battery voltage
100%	1.295	1.287	12,66
75%	1.253	1.246	12,45
50%	1.217	1.210	12,30
25%	1.177	1.170	12,00
Discharged	1.137	1.130	11,84

The specific gravity should not vary more than 0.025 points between the various cells.

4. If the specific gravity is 1.280 or more, the battery is fully charged and in good operating conditions.
5. If the correct specific gravity is less than 1.280, charge the battery and check the charging system to find out why the battery charge is low.

> ☞ If distilled water has been added recently, the battery must be recharged for a short period of time, otherwise the densimeter will be unable to give precise readings.

If the battery has been charged in static conditions, the electrolyte that accumulates at the bottom of the elements will be more dense. The battery must be shaken every so often in order to mix the electrolyte: this will improve the charge current and will allow the densimeter to give more accurate readings during the tests.

Efficiency test

The efficiency test allows you to ascertain whether the capacity of the battery is sufficient to start the engine. The voltage reading obtained is used to identify the battery condition. Before conducting the test, make sure that the level of the battery acid is correct and that the open circuit voltage is 12.5V or more. The battery can be tested either on or disconnected from the tractor.

1. Set the current control switch of the battery starting tester (high current discharge tester) to the “off” position and the voltage selector switch to the nominal voltage of the battery or slightly higher. Connect the positive conductors of the tester to the positive battery terminal and the negative conductors to the negative battery terminal.
2. Turn the current control knob until the reading on the amperometer is half the cold starting current of the battery. Now read the voltage value.
   - If the reading is 9.6 V or more after 15 seconds, the battery has an acceptable delivered energy capacity and will promptly accept a nominal charge.
   - If the reading is below 9.6 V, the battery must be considered unsatisfactory for use and the charge must be tested as described below.

> **CAUTION**
>
> ! Do not leave the current charge on the battery for more than 15 seconds.

Test conditions: Only batteries that have not passed the previous capacity test need to be subjected to this test.

1. Connect the positive conductors of the starter tester to the positive battery terminal and the negative conductors to the negative battery terminal.
2. Connect the positive conductor of the battery charger to the positive battery terminal and the negative conductor to the negative battery terminal.
3. Turn the battery charger timer beyond the "3 minutes" charge indication and then to the "3 minutes" mark again.
4. Set the charge current as near to 40 A as possible.
5. Check the voltmeter reading after 3 minutes of this quick charge.
   - If the total voltage exceeds 15.5 V, the battery is unsatisfactory. It is probably sulphated or worn and must be replaced.

> ☞ A slightly sulphated battery can be recovered by using a battery charger of the multiple type, with a 50 V higher open circuit voltage limit. In view of the high resistance of a sulphated battery, a higher voltage value must be selected initially in order to overcome the sulphation resistance. There may be no visible acceptance of the charge at the beginning. A small charge will appear after a few minutes, followed by a fast increase in the amperage. The current must not exceed 14 A and the temperature of the electrolyte must not exceed 50°C. When the current has stabilized, restore the voltage until a permanent 5 A has been reached. Continue with this current until the specific gravity of the electrolyte stops rising at about 1.275-1.280 at 20°C. This could require 48 hours charging. Allow the battery to rest for 24 hours and then conduct the previously described capacity test.

   - If the total voltage is below 15.5 V, test the specific gravity of each element and recharge the battery according to the following scale:

Specific gravity	Rapid charge until:
1.150 or less	60 minutes
from 1.151 to 1.175	45 minutes
from 1.176 to 1.200	30 minutes
from 1.200 to 1.225	15 minutes

COMMON CAUSES OF BATTERY FAULTS

1. Internal circuit open.
2. Internal short-circuit.
3. Leaking electrolyte.
4. Separation of active substances from the grids.
5. Accumulation of sulphate crystals too large to disperse.

These faults normally have the following causes:

1. Faulty components inside the element.
2. Excessive development of crystals which could perforate the separators and cause short-circuits.
3. Excessive overload (faulty operation of the charging system, rapid charging and high voltage restoration techniques, operation at very high temperatures).
4. Freezing electrolyte.
   A fully charged battery will not freeze until a temperature of -65°C. A half-charged battery freezes between -17°C and -27°C. Completely discharged electrolyte freezes from -3°C to -11°C. An excessively high fast charge and gassing also cause the active substances to separate from the grids. Separation destroys the chemical function of the battery.
5. Crystals develop whenever batteries are left to remain discharged. High temperatures and lengthy discharge periods favour this condition. It is unlikely for a battery to be recovered on a vehicle after a week, at ambient temperature. Recharging will require a higher constant voltage. After 3 weeks, the battery will have been subjected to a permanent degradation and the previously described procedure must be used in order to charge a "very discharged" battery.

Batteries last a long time when they are fully charged. Pb-Ca batteries discharge 3% per month. This means that a battery takes 16 months for its charge to become halved. The inactive charge is about 50mA on tractors. To forecast discharging on a static vehicle, add this value as though it corresponded to about 8Ah per week.

It is worthwhile noting that if a battery begins to fade during the starting phase, it is better to stop for two minutes and allow it to recover. The colder the temperature, the longer the battery will take to recover.

SECTION 1050

ELECTRICAL SYSTEM – ELECTRICAL CIRCUITS

INDEX

ELECTRICAL SYSTEM COMPONENTS

1	Battery
2	Rh headlight
3	Lh headlight
4	Clogged air filter sensor
5	Engine coolant temperature sensor
6	Horn
7	Alternator
8	Motor stop solenoid valve
9	Diff lock solenoid valve
10	Engine housing ground
11	Thermostarter
12	Rh turn indicator and side light
13	Fuse box
14	Fuel level transmitter
15	Rh brake light switch
16	Lh brake light switch
17	Diff lock control switch
18	Rh rear light
19	Rear PTO speed indicator switch
20	License plate light
21	Reverse shuttle lever safety switch
22	Underbelly PTO engaged indicator light switch
23	Lh rear light
24	Parking brake engaged indicator light switch
25	Rear transmission ground
26	Lh turn indicator and side light
27	4WD indicator light switch
28	Rear PTO safety switch
29	40 A maxi fuse for cab system supply (cab version – installed in fuse box)
30	Engine oil pressure sensor
31	Rotating beacon
32	Starter motor
33	Rear wiring connection (24 PIN)

ELECTRICAL SYSTEM COMPONENTS (continued)

34 License plate wiring connection (10 PIN)

35 Cab wiring connection (12 PIN) (version with cab)

36 60 A maxi fuse for direct ignition switch power supply

37 Engine wiring connection (24 PIN)

38 Operator safety wiring connection (8 PIN)

39 40 A maxi fuse for ignition glow plugs (mounted in fuse box)

40 60 A maxi fuse for general power supply (mounted in fuse box)

41 Dipped beam relay

42 Driving beam relay

43 Diff lock circuit relay

44 Operator safety PTO relay

45 Ignition enabling relay

46 Hazard light and turn indicator blinker

47 Measuring instrument

48 Hazard light control switch

49 Front PTO safety switch

50 Ignition switch

51 Rotating beam control switch

52 External light switch

53 Connection for ISO/NAO version (3 PIN)

54 Diode for measuring instrument

55 Field light control switch

56 NAO plant

57 Lh front turn indicator light (NAO version only)

58 Rh front turn indicator light (NAO version only)

59 Resistance – diode holder connection

60 Main ground for dashboard

61 Seven-pin socket

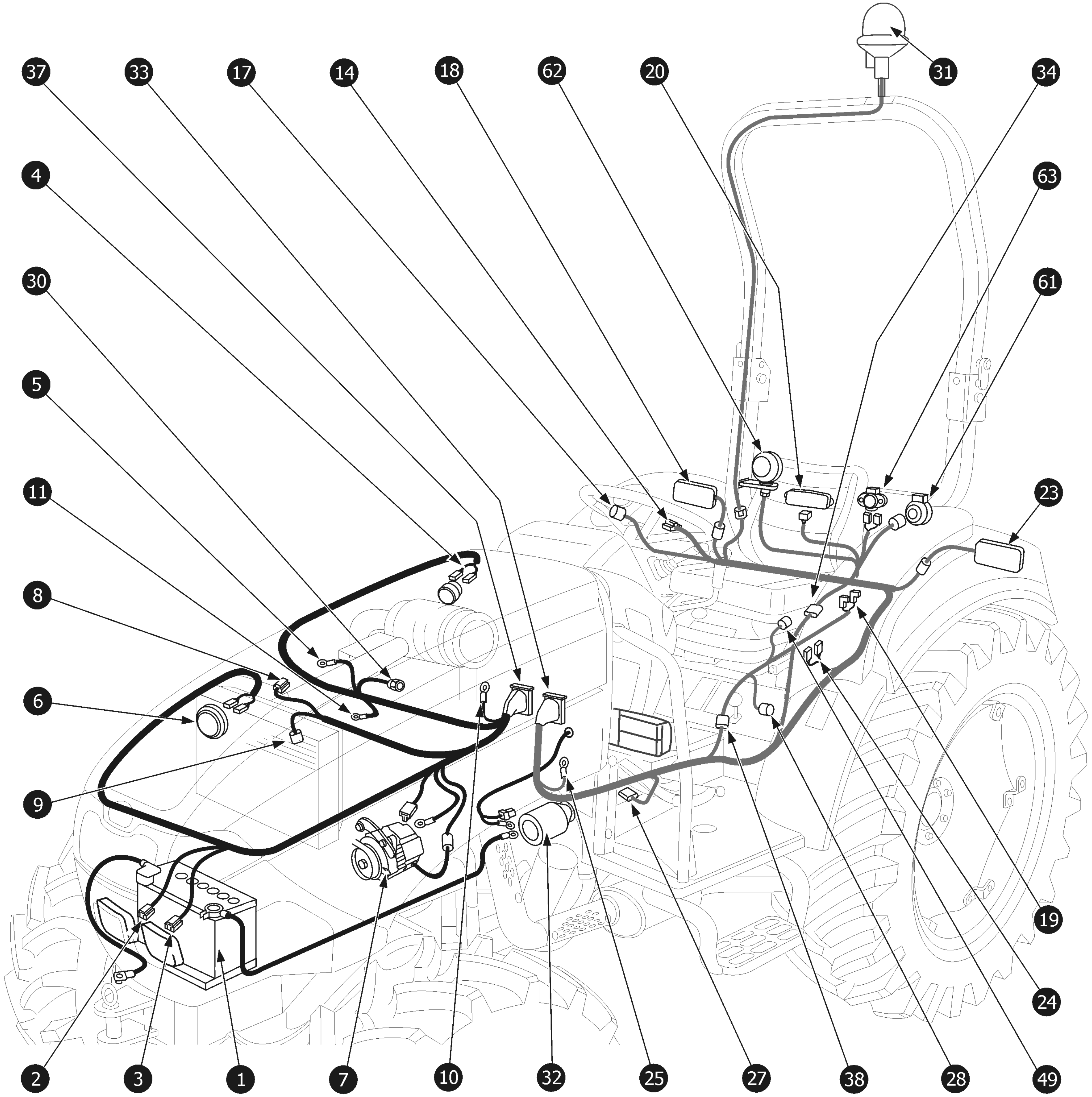
62 Field light

63 25A power socket

64 Conditioning system drier filter sensor (cab version)

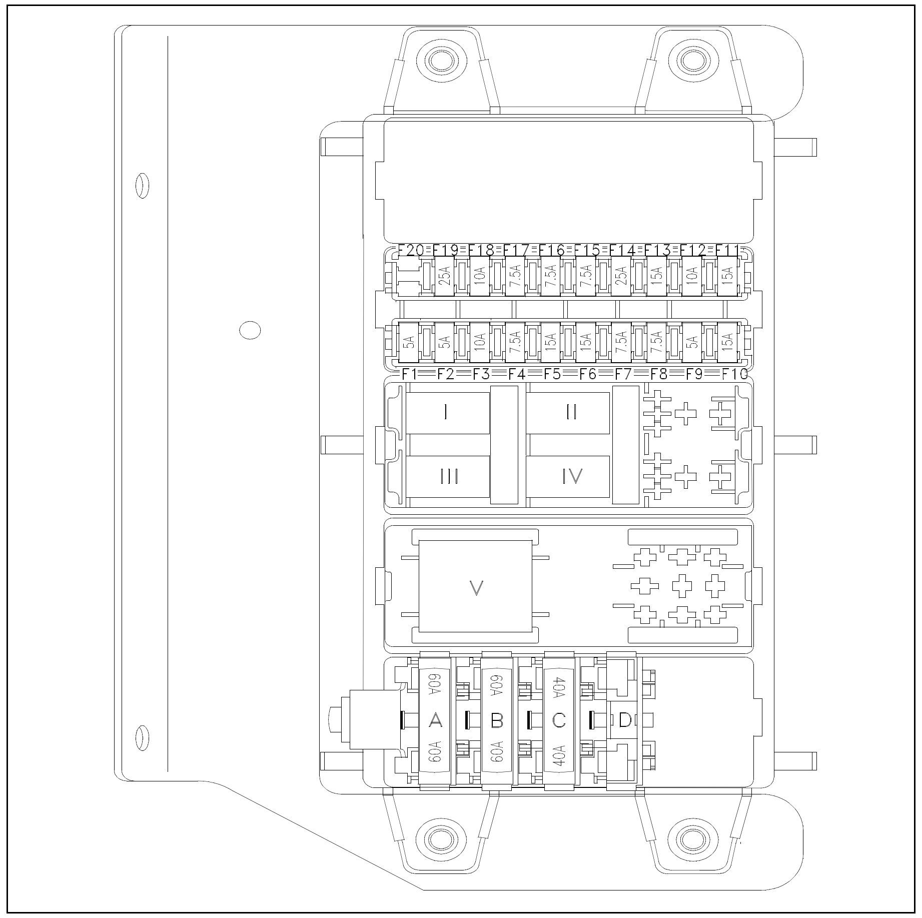
65 Conditioner compressor (cab version)

TRACTOR – COMPONENT LOCATIONS



TRACTOR – COMPONENT LOCATIONS

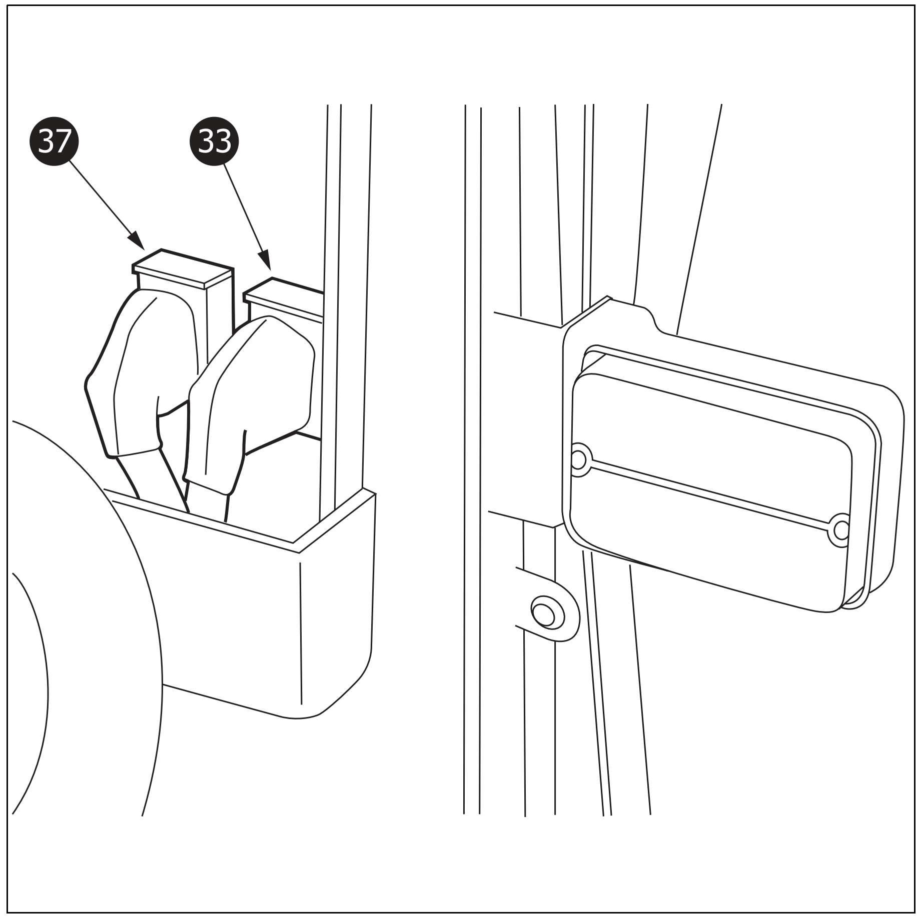
A



1

Relays and fuse box

B

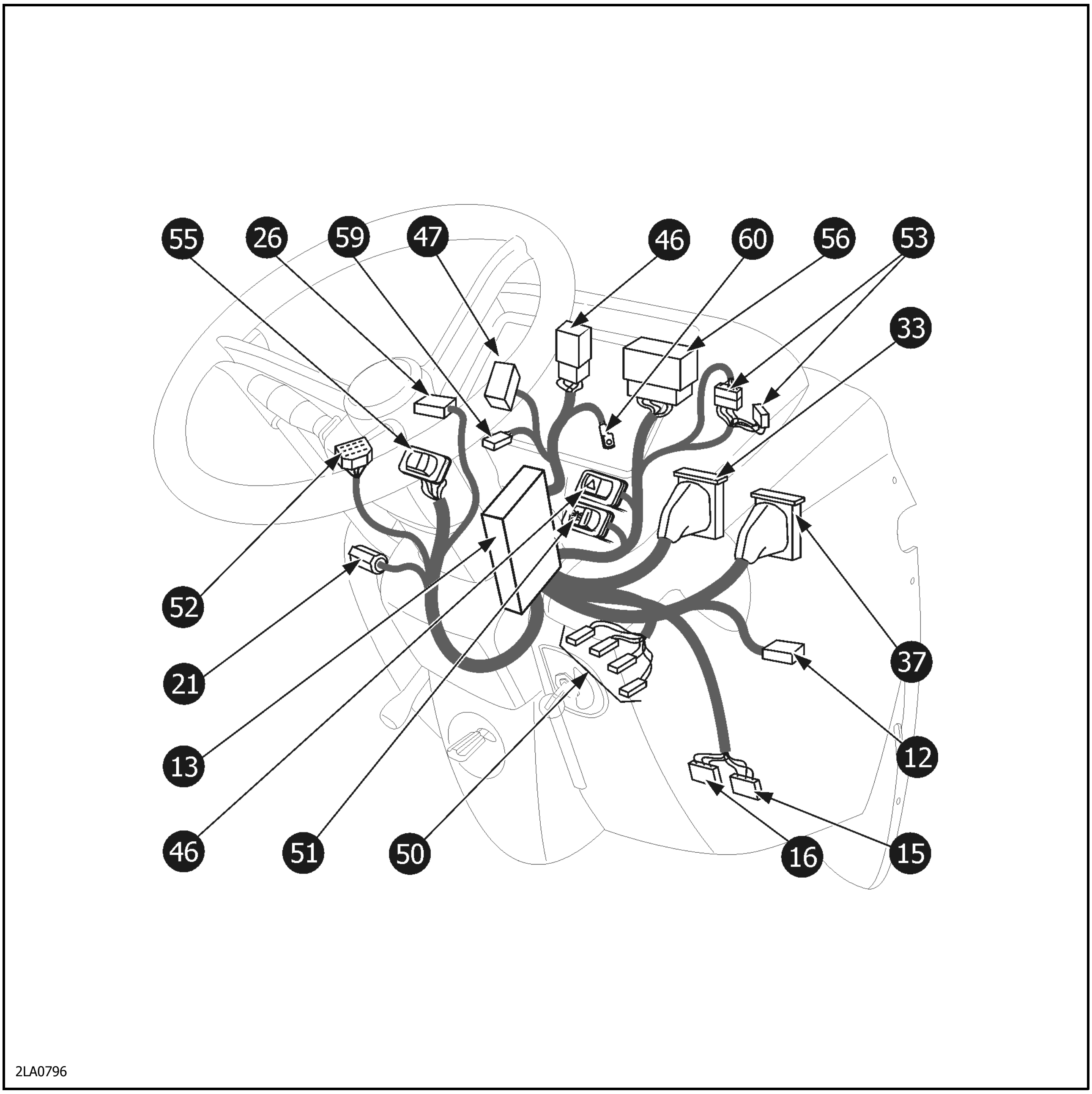


2

Left side of engine

2LA0512

CONTROL PANEL – COMPONENT LOCATIONS



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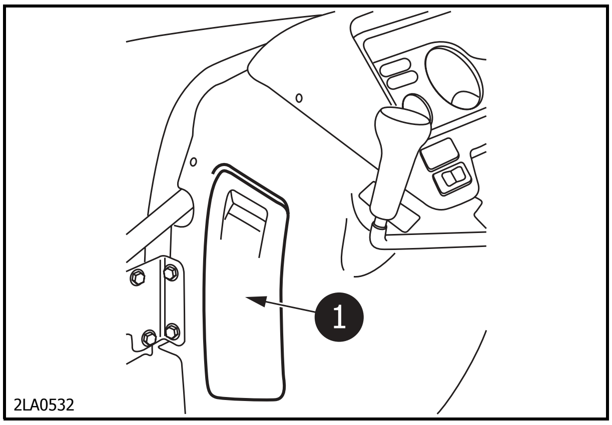
LOCATIONS OF FUSES AND RELAYS

Fuse box



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> **CAUTION**
> When fuses must be changed, make sure that the new fuse has the same rating as the old one. Even though they are interchangeable, use of different fuses would seriously impair tractor operation.

Fuse box location

The fuse box is installed inside the instrument panel, on the left-hand side. Remove the panel (1) in order to access the fuse box.

> **CAUTION**
> When the relay in the electrical system must be changed, make sure that the new relay is the same type as the old one. Even though they are interchangeable, use of different relays would seriously impair tractor operation.

RELAY FUNCTIONS:

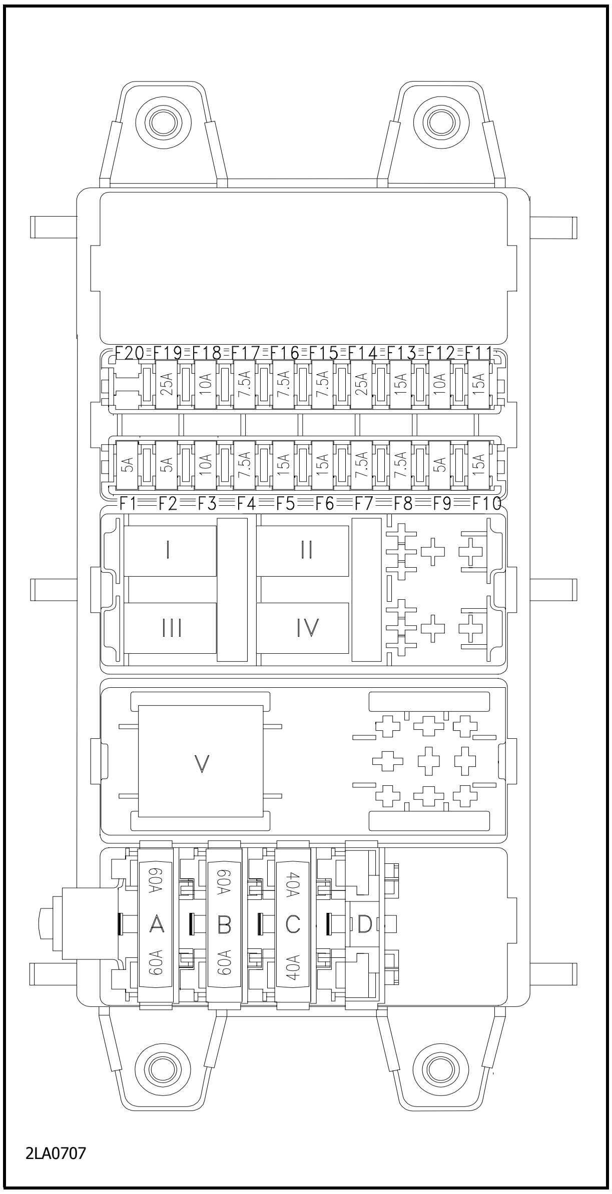
I Dipped beam relay

II Driving beam relay

III PTO safety relay

IV Diff lock solenoid valve relay

V Ignition relay.



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FUSES

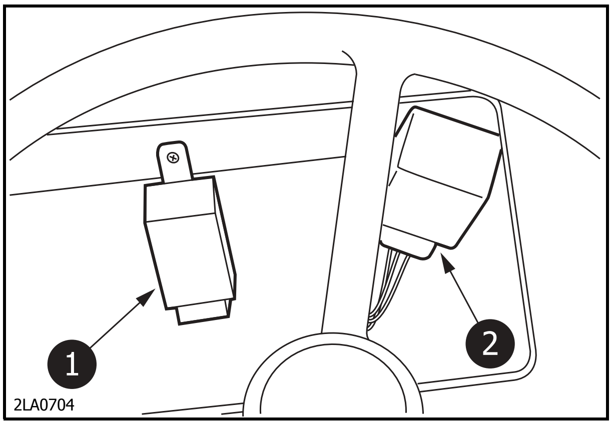
Valves	CIRCUITS PROTECTED	Amp.
F1	Diff lock solenoid valve	5
F2	PTO brake, PTO safety	5
F3	Brake lights	10
F4	Instrument, alternator diode	7.5
F5	Driving beams	15
F6	Dipped beams	15
F7	Rh side lights	7.5
F8	Lh side lights	7,5
F9	Courtesy lights	5
F10	Key-operated power supplies, hazard light control switch	15
F11	Hazard light and turn indicator blinker	15
F12	NAO circuit	10
F13	Power supply to hazard light switch	15
F14	Light switch	25
F15	Horn	7.5
F16	Rotating beacon	7.5
F17	Field light	7.5
F18	Motor stop solenoid valve	10
F19	25A power socket	25
F20	Unused	-

MAXI FUSES

A	Power supply to ignition switch	60
B	General power supply	60
C	Glow plugs	40
D	Cab system power supply (cab version)	40

HAZARD LIGHTS AND TURN INDICATOR BLINKERS – NAO PLANT (NORTH AMERICAN markets)

Both the turn indicator blinker (1) and the NAO plant (2) (for the North American markets) are installed inside the instrument panel.

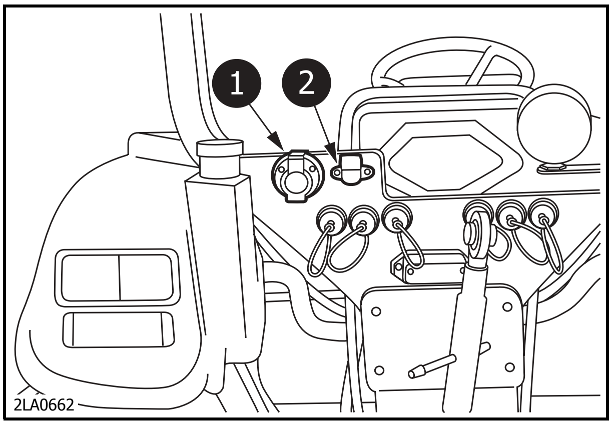


6

POWER SOCKET – SEVEN-PIN CONNECTION

These are installed in the rear left-hand part of the tractor (fig. 7)

1. Seven-pin connection
2. Power socket



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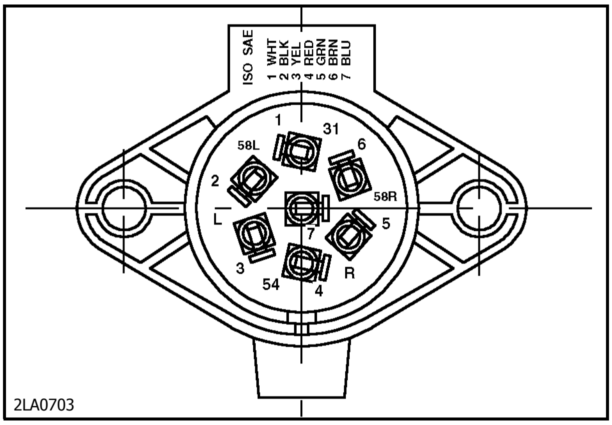
See fig. 8 (rear view) for the location of the pins in the connection.



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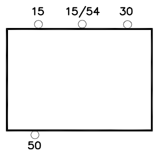
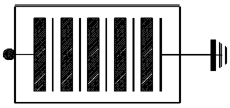
SYMBOLS USED IN THE ELECTRICAL CIRCUITS

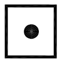


Ignition switch

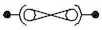
Maxi fuse



Battery



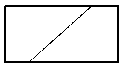
Connection



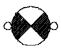
Fuse

Connection

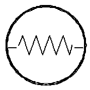
Motor



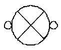
Solenoid valve



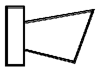
Lighting and indicator lamp



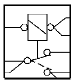
Thermostarter



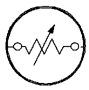
Instrument lighting lamp



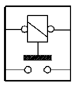
Horn



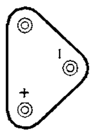
Switch relay



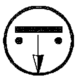
Variable resistance



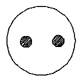
Switch relay



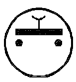
Instrument



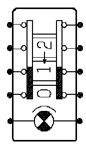
Pressure switch



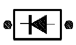
Power socket



Indicator switch



Control switch

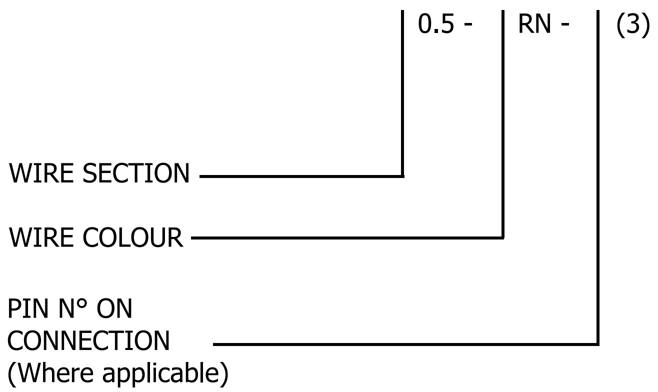


Diode

COLOUR CODES OF THE ELECTRICAL WIRES

A	Light blue	**HV**	Grey green
AN	Light blue black	**HG**	Grey yellow
AG	Light blue yellow	**I**	Blue
AB	Light blue white	**LB**	Blue white
AV	Light blue green	**LN**	Blue black
AR	Red light blue	**LR**	Blue red
B	White	**M**	Brown
BR	White red	**MB**	Brown white
BN	White black	**MN**	Brown black
BL	White blue	**N**	Black
BG	White yellow	**NZ**	Black purple
C	Orange	**NB**	Black white
CB	Orange white	**NR**	Black red
CN	Orange black	**R**	Red
CL	Orange blue	**RG**	Red yellow
G	Yellow	**RN**	Red black
GV	Yellow green	**RV**	Red green
GN	Yellow black	**S**	Pink
GR	Yellow red	**SN**	Pink black
GL	Yellow blue	**SG**	Pink yellow
H	Grey	**V**	Green
HM	Grey brown	**VN**	Green black
HR	Grey red	**VB**	Green white
HN	Grey black	**Z**	Purple
HB	Grey white	**ZB**	Purple white
HL	Grey blue	**ZN**	Purple black

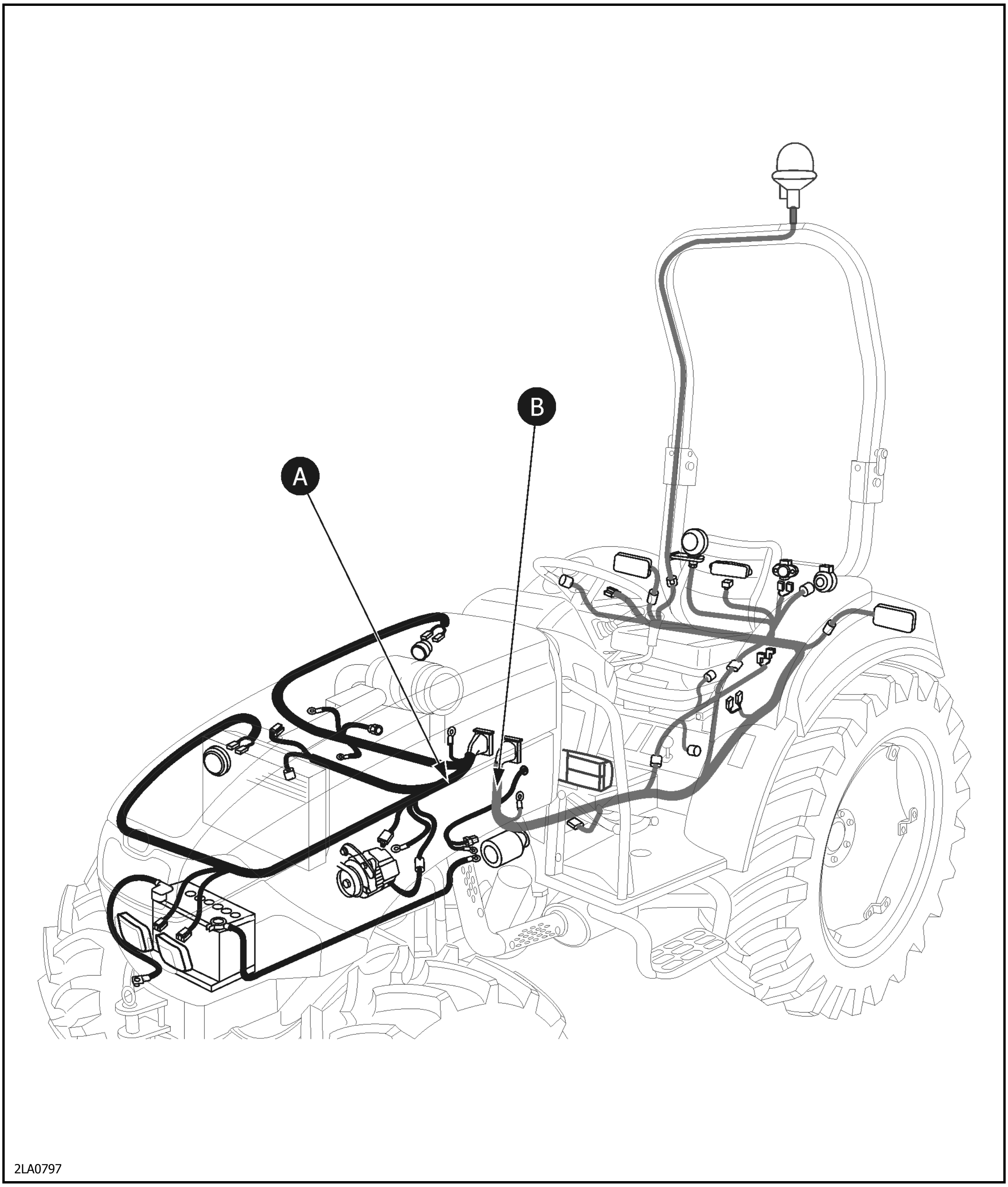
IDENTIFICATION CODE OF THE WIRING DIAGRAMS AND CONNECTIONS



MAIN WIRING AND WIRING DIAGRAMS

DESCRIPTION	DIAGRAM
MAIN FRONT WIRING	
- STARTING AND RECHARGING DIAGRAM	A
- OPERATOR SAFETY DIAGRAM	B
- DIAGRAM OF SIDE LIGHTS, DRIVING BEAMS, DIPPED BEAMS, LICENSE PLATE LIGHT AND INSTRUMENT LIGHTING	C
- DIAGRAM OF TURN INDICATORS AND HAZARD LIGHTS - HORNS	D
MAIN REAR WIRING	
- DIAGRAM OF BRAKE LIGHTS – FIELD LIGHT – ROTATING BEACON – DIFFERENTIAL LOCK	E
- DIAGRAM OF SENSORS AND TRANSMITTERS	F
- DIAGRAM OF 7-PIN SOCKET, POWER SOCKET	G

MAIN WIRING



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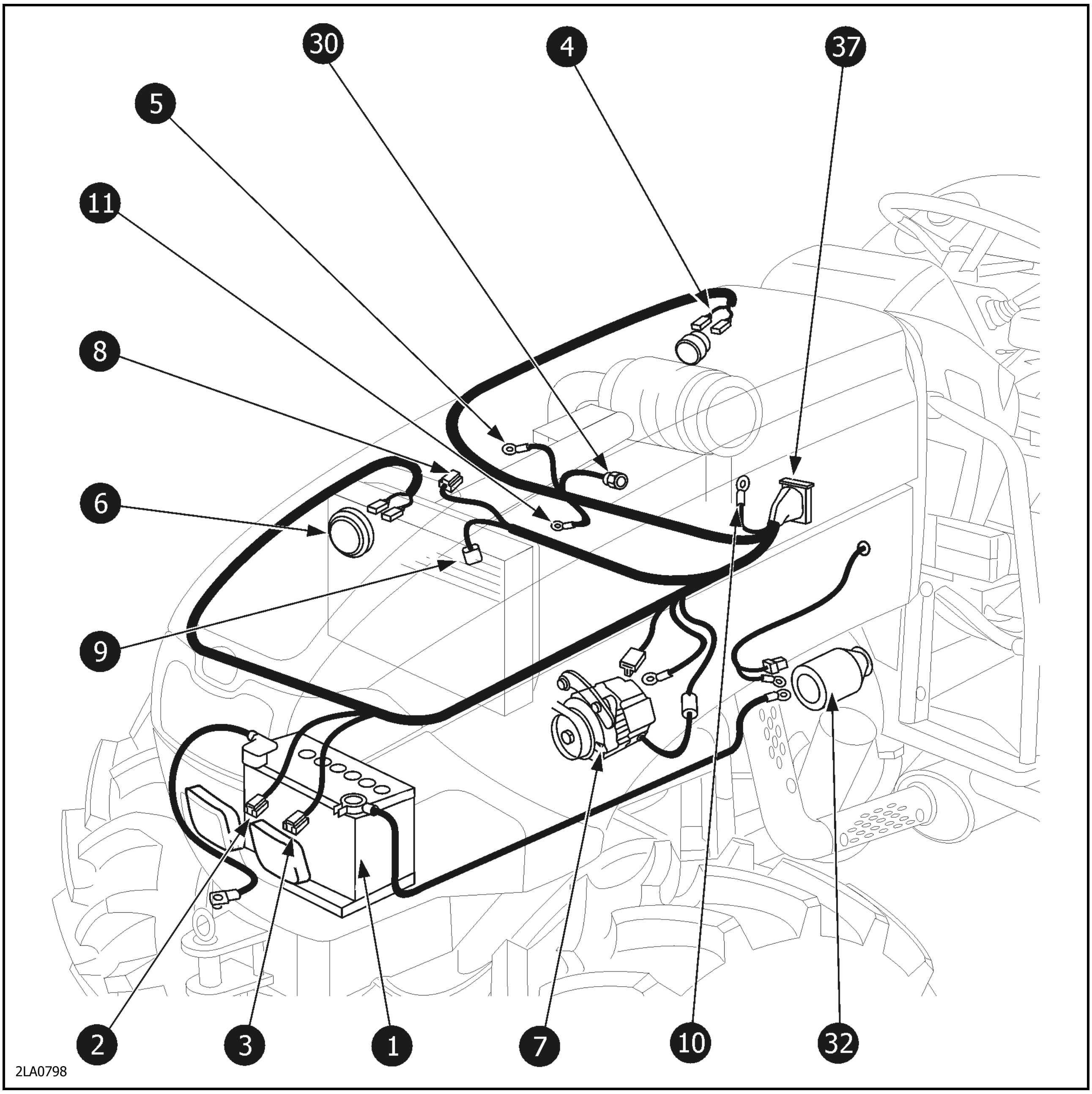
A. Front wiring

B. Rear wiring



10

MAIN FRONT WIRING (diagram of engine and lights)

1	Battery
2	Rh headlight
3	Lh headlight
4	Clogged air filter sensor
5	Engine coolant temperature sensor
6	Horn
7	Alternator
8	Motor stop solenoid valve
9	Diff lock solenoid valve
10	Engine housing ground
11	Thermostarter
30	Engine oil pressure sensor
32	Starter motor
37	Engine wiring connection (24 PIN)

STARTING AND RECHARGING DIAGRAM
(Diagram A)

1 Battery

7 Alternator

8 Motor stop solenoid valve

11 Thermostarter

13 Fuse box

- F4 Instrument, alternator diode
- F18 Motor stop solenoid valve

32 Starter motor

36 60 A maxi fuse for power supply to ignition switch

37 Engine wiring connection (24 PIN)

39 40 A maxi fuse for ignition glow plugs

40 60 A maxi fuse for general power supply

45 Ignition relay

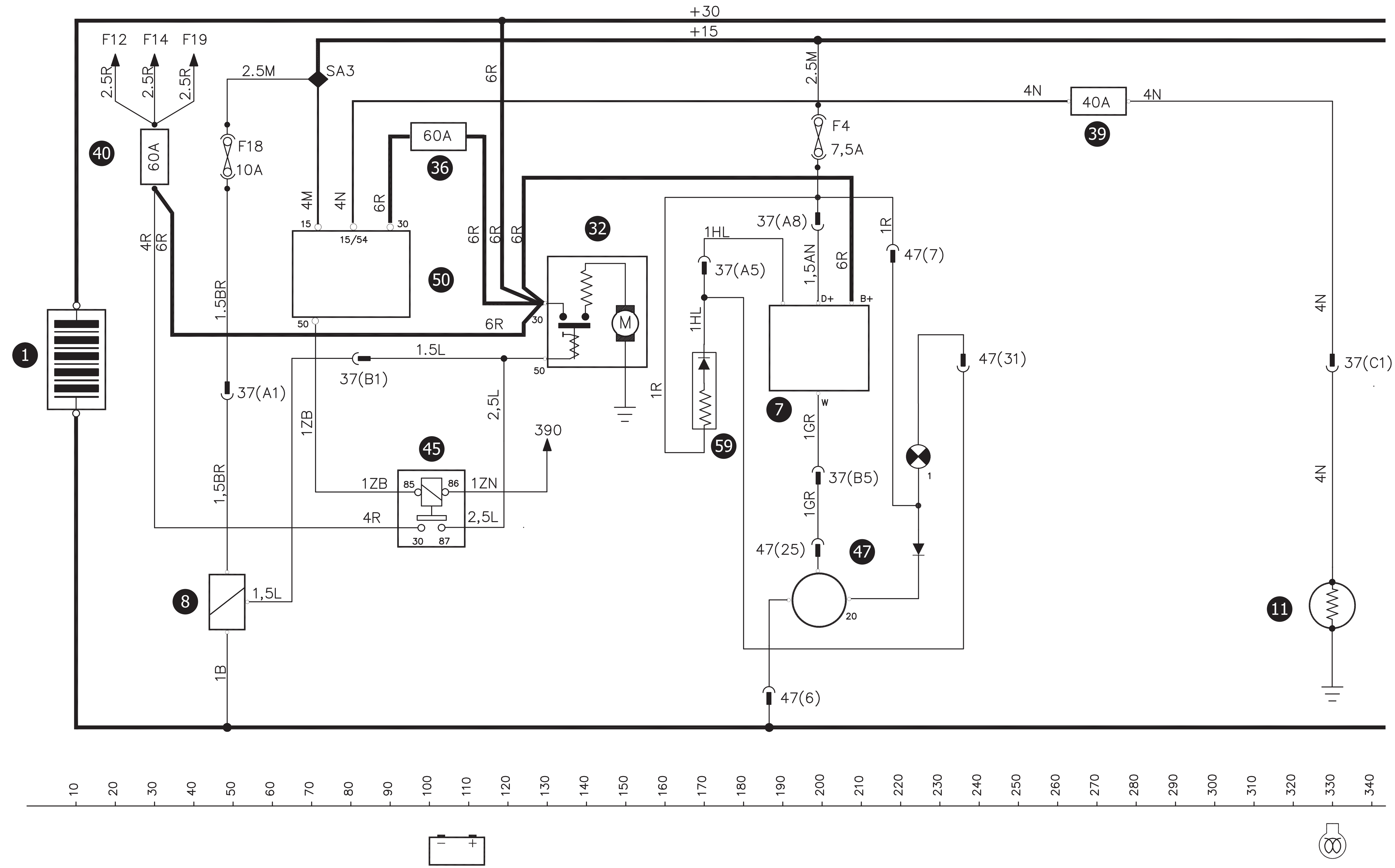
47 Measuring instrument

- 1 Battery recharging circuit
- 20 RPM counter and hour counter instrument

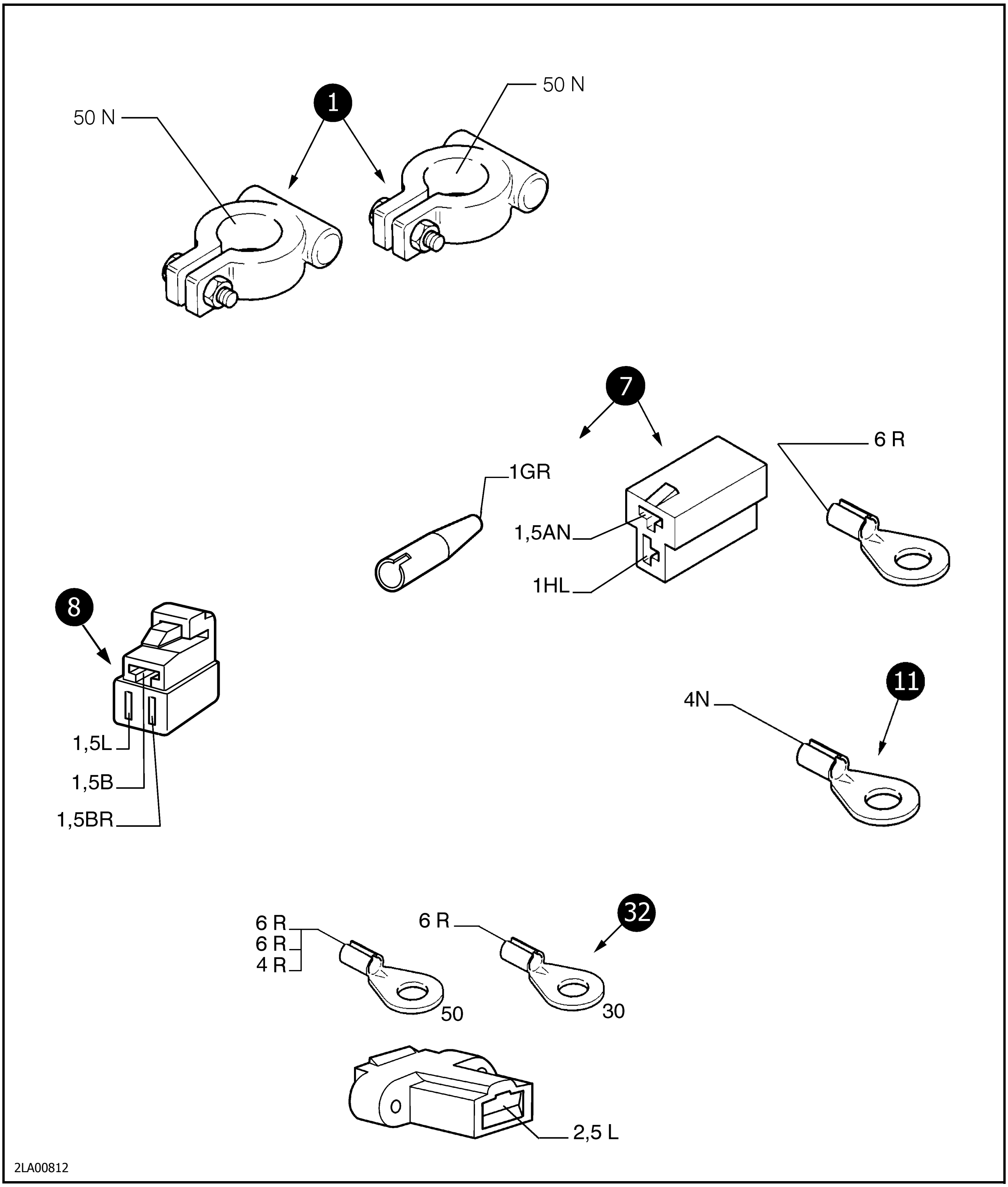
50 Ignition switch

59 Resistance – diode holder connection

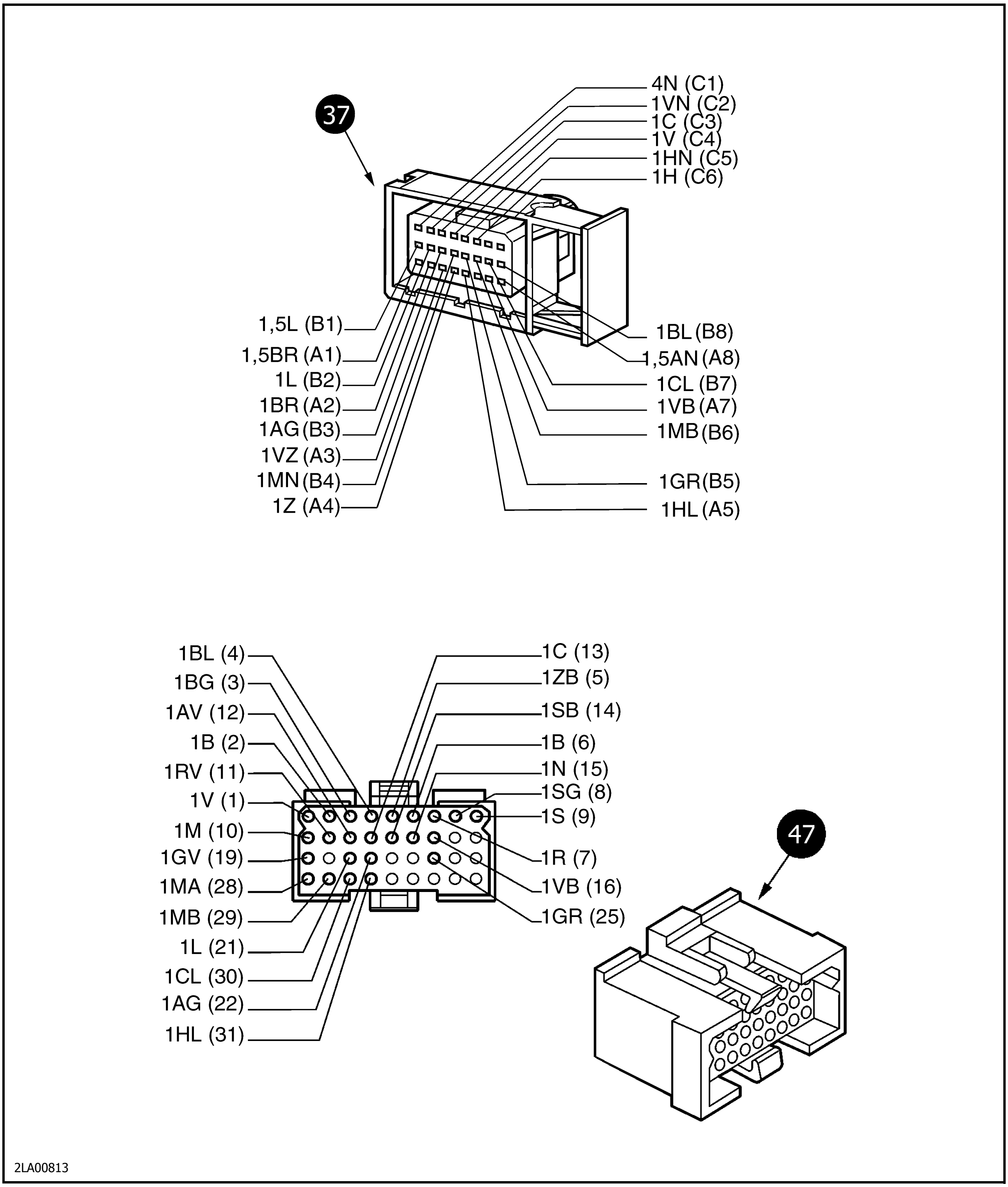
STARTING AND RECHARGING DIAGRAM – Diagram A



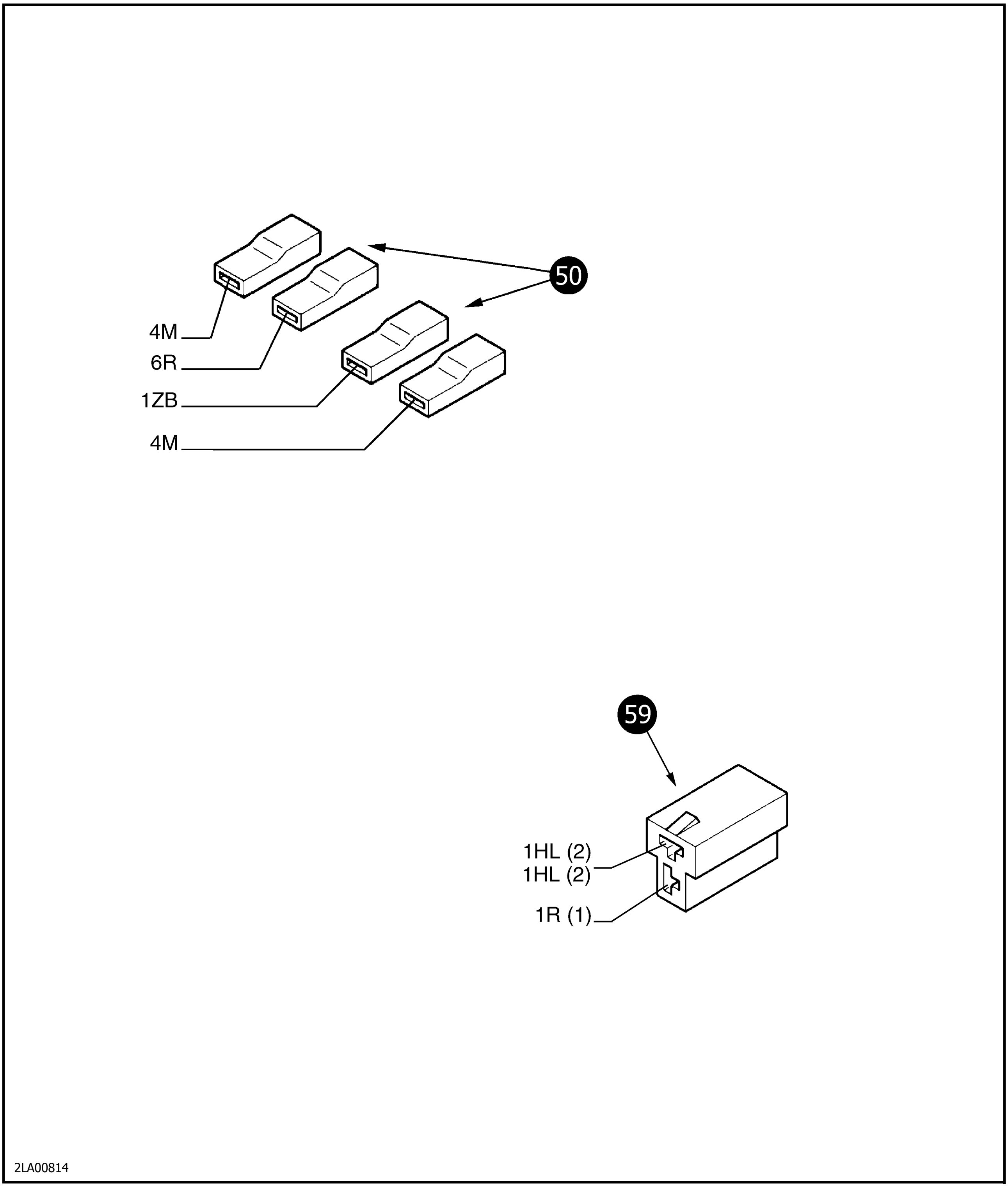
2LA0764


1
50 N
50 N
7
1GR
1,5AN
1HL
6 R
8
1,5L
1,5B
1,5BR
11
4N
32
6 R
6 R
4 R
6 R
50
30
2,5 L
2LA00812

11


37
4N (C1)
1VN (C2)
1C (C3)
1V (C4)
1HN (C5)
1H (C6)
1,5L (B1)
1,5BR (A1)
1L (B2)
1BR (A2)
1AG (B3)
1VZ (A3)
1MN (B4)
1Z (A4)
1BL (B8)
1,5AN (A8)
1CL (B7)
1VB (A7)
1MB (B6)
1GR (B5)
1HL (A5)
1BL (4)
1BG (3)
1AV (12)
1B (2)
1RV (11)
1V (1)
1M (10)
1GV (19)
1MA (28)
1MB (29)
1L (21)
1CL (30)
1AG (22)
1HL (31)
1C (13)
1ZB (5)
1SB (14)
1B (6)
1N (15)
1SG (8)
1S (9)
1R (7)
1VB (16)
1GR (25)
47
2LA00813

12



13

OPERATOR SAFETY DIAGRAM
(Diagram B)

13 Fuse box
- F2 PTO safety
- F4 Instrument, alternator diode

21 Reverse shuttle lever safety switch

28 Rear PTO safety switch

33 Rear wiring connection (24 PIN)

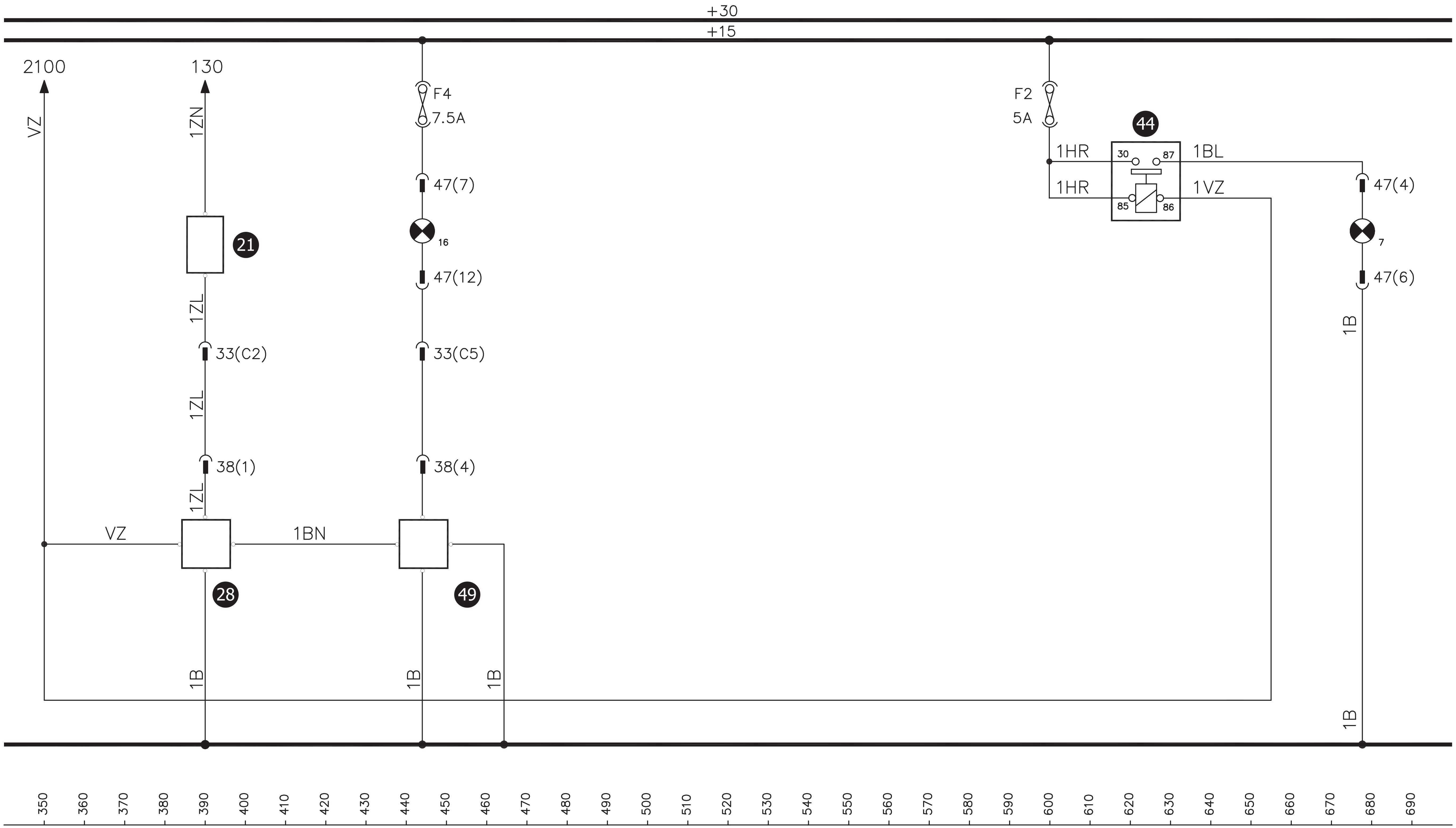
38 Operator safety wiring connection (8 PIN)

44 Operator safety PTO relay

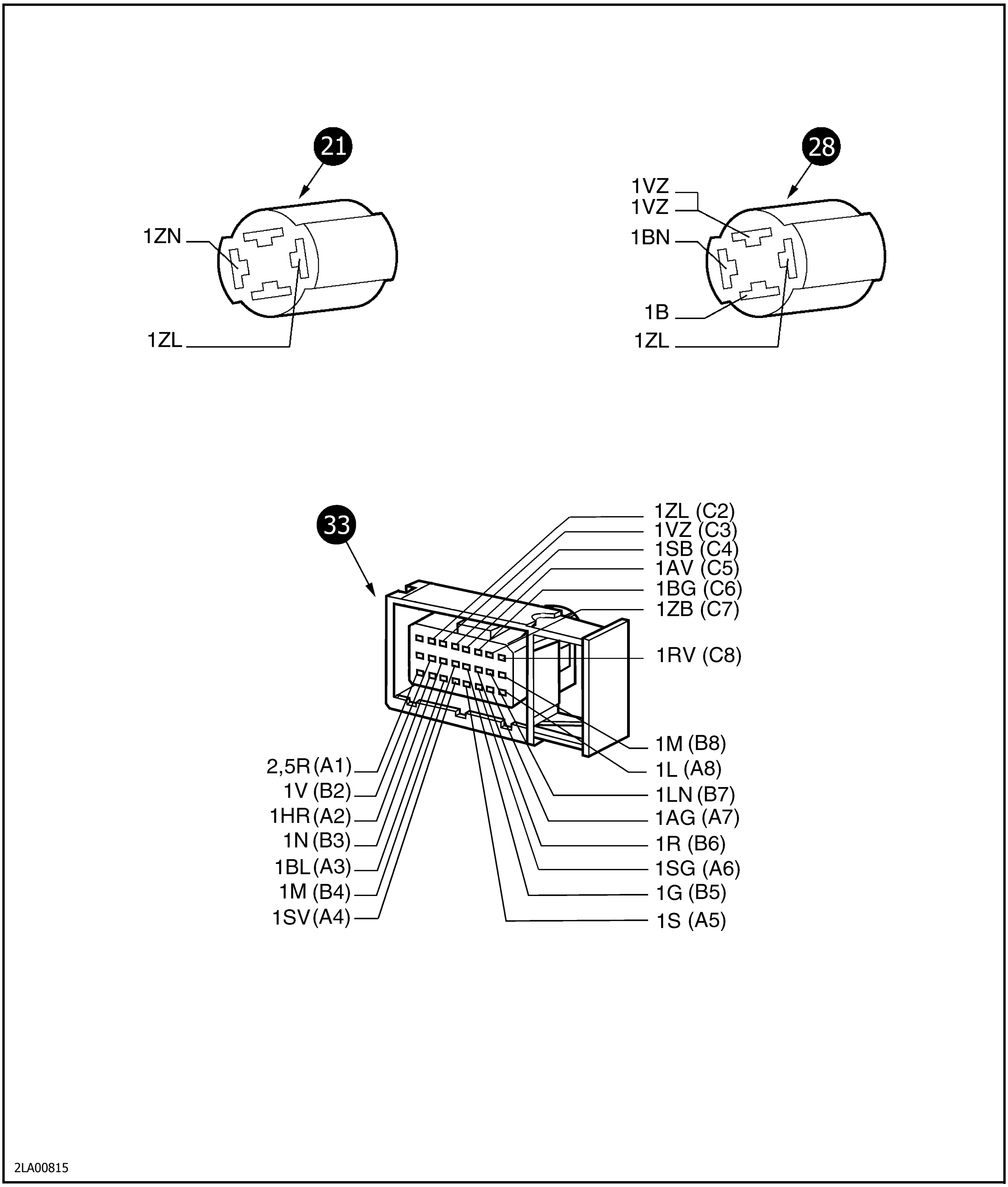
47 Measuring instrument
- 7 Rear PTO engaged
- 16 Front PTO engaged

49 Front PTO safety switch

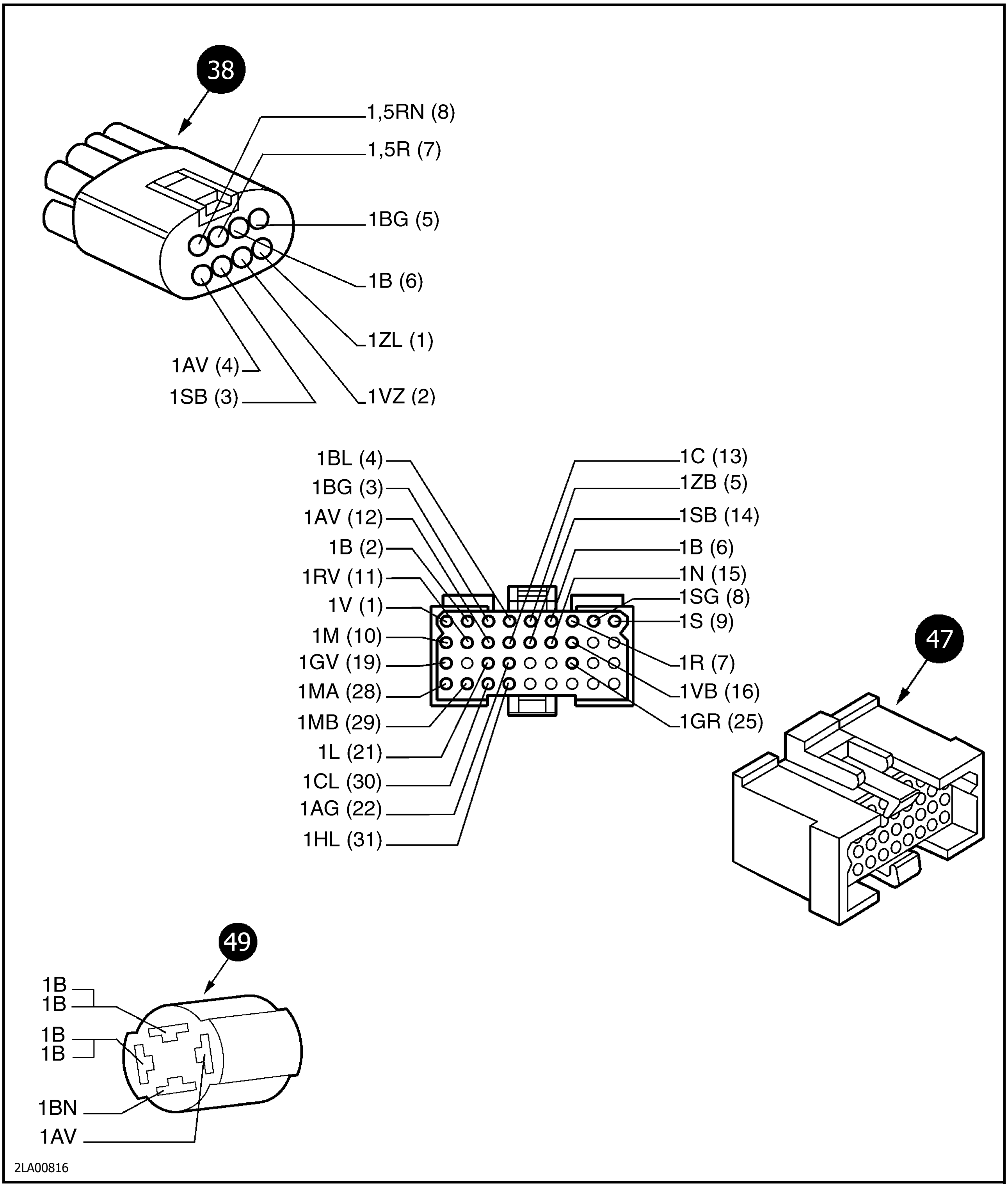
OPERATOR SAFETY DIAGRAM - (Diagram B)



2LA0765


21
1ZN
1ZL
28
1VZ
1VZ
1BN
1B
1ZL
33
1ZL (C2)
1VZ (C3)
1SB (C4)
1AV (C5)
1BG (C6)
1ZB (C7)
1RV (C8)
1M (B8)
1L (A8)
1LN (B7)
1AG (A7)
1R (B6)
1SG (A6)
1G (B5)
1S (A5)
2,5R (A1)
1V (B2)
1HR (A2)
1N (B3)
1BL (A3)
1M (B4)
1SV (A4)
2LA00815

14


38
1,5RN (8)
1,5R (7)
1BG (5)
1B (6)
1ZL (1)
1AV (4)
1SB (3)
1VZ (2)
1BL (4)
1BG (3)
1AV (12)
1B (2)
1RV (11)
1V (1)
1M (10)
1GV (19)
1MA (28)
1MB (29)
1L (21)
1CL (30)
1AG (22)
1HL (31)
1C (13)
1ZB (5)
1SB (14)
1B (6)
1N (15)
1SG (8)
1S (9)
1R (7)
1VB (16)
1GR (25)
47
49
1B
1B
1B
1B
1BN
1AV
2LA00816

15

DIAGRAM OF SIDE LIGHTS, DRIVING BEAMS, DIPPED BEAMS, LICENSE PLATE LIGHT AND INSTRUMENT LIGHTING (Diagram C)

2 Rh headlight

3 Lh headlight

12 Rh turn indicator and side light

13 Fuse box

- F5 Driving beams
- F6 Dipped beams
- F7 Rh side lights
- F8 Lh side lights
- F14 Light switch

18 Rh side light

20 License plate light

23 Lh rear light

26 Lh turn indicator and side light

33 Rear wiring connection (24 PIN)

34 License plate wiring connection (10 PIN)

37 Engine wiring connection (24 PIN)

40 60 A maxi fuse for general power supply

41 Dipped beam relay

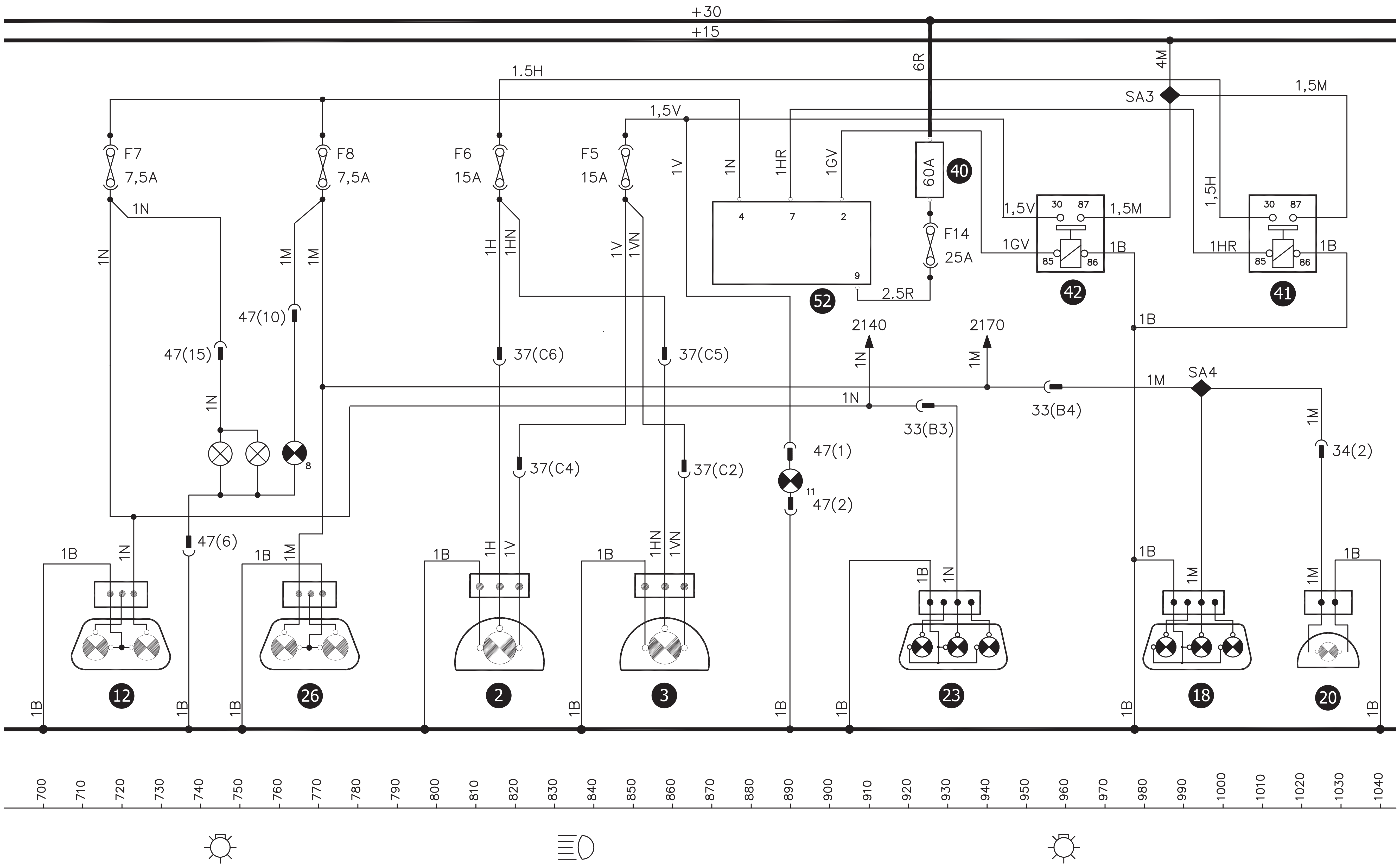
42 Driving beam relay

47 Measuring instrument

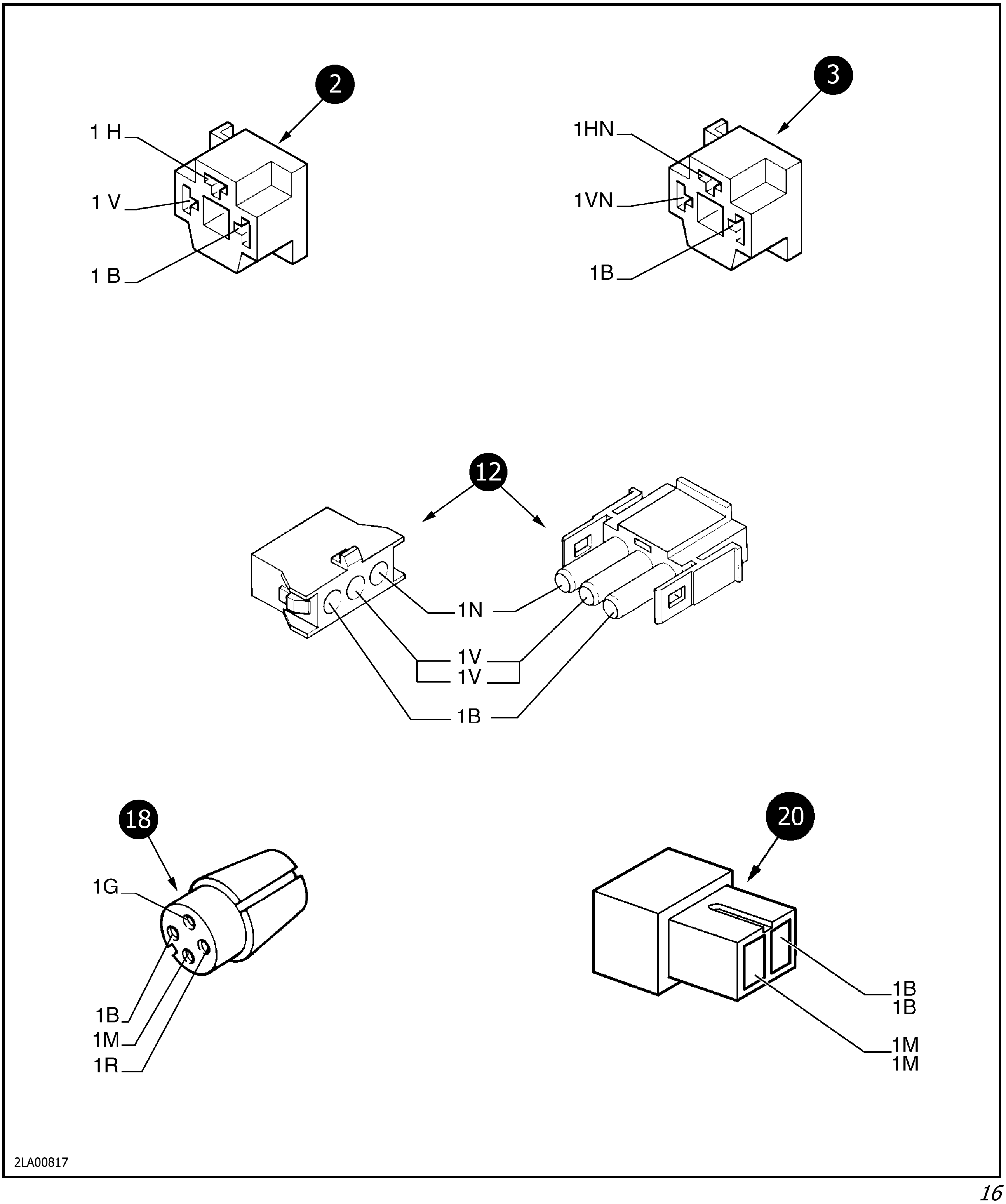
- 8 Side lights
- 11 Driving beams

52 External light switch

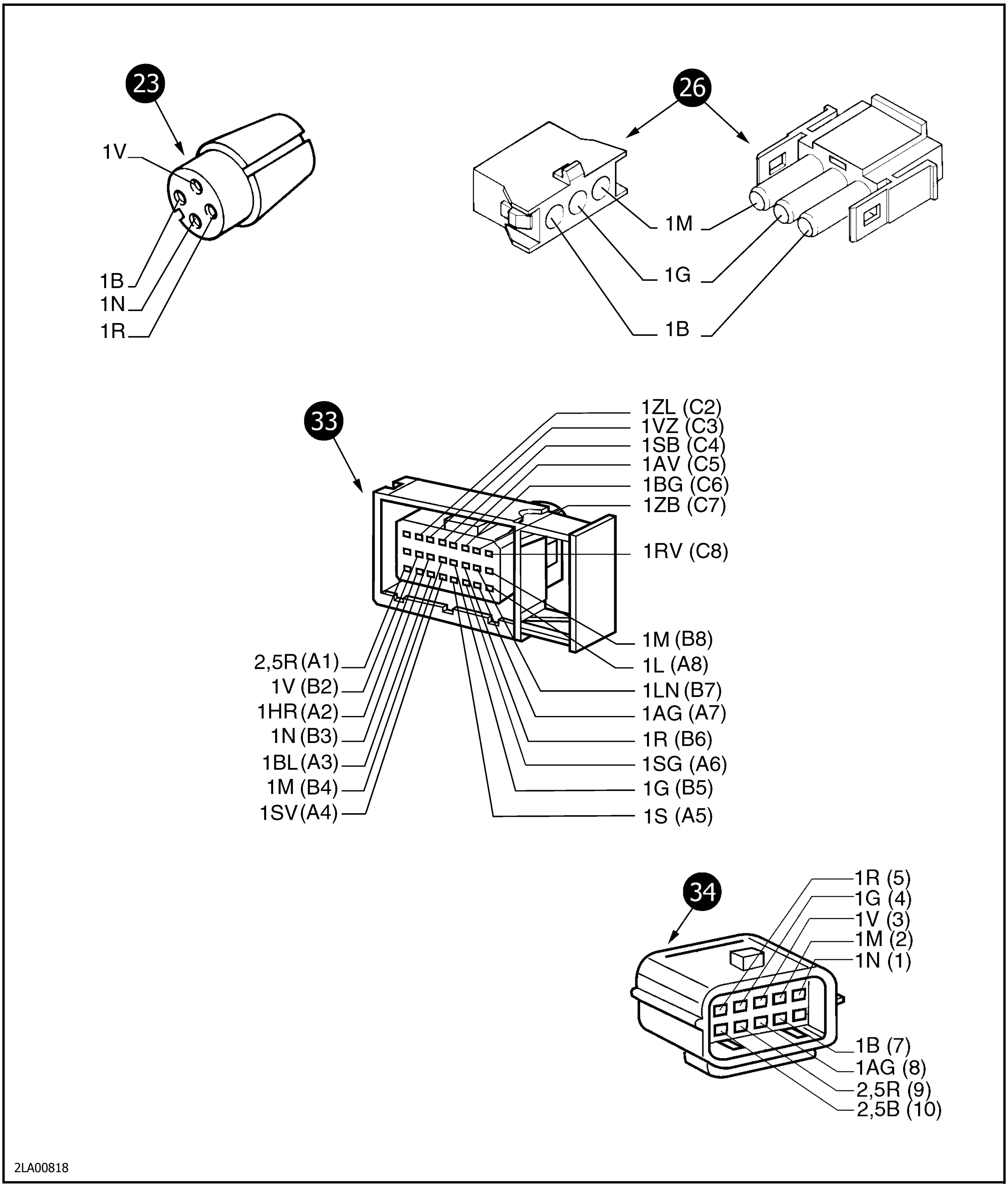
DIAGRAM OF SIDE LIGHTS, DRIVING BEAMS, DIPPED BEAMS, LICENSE PLATE LIGHT AND INSTRUMENT LIGHTING - Diagram C



2LA0766

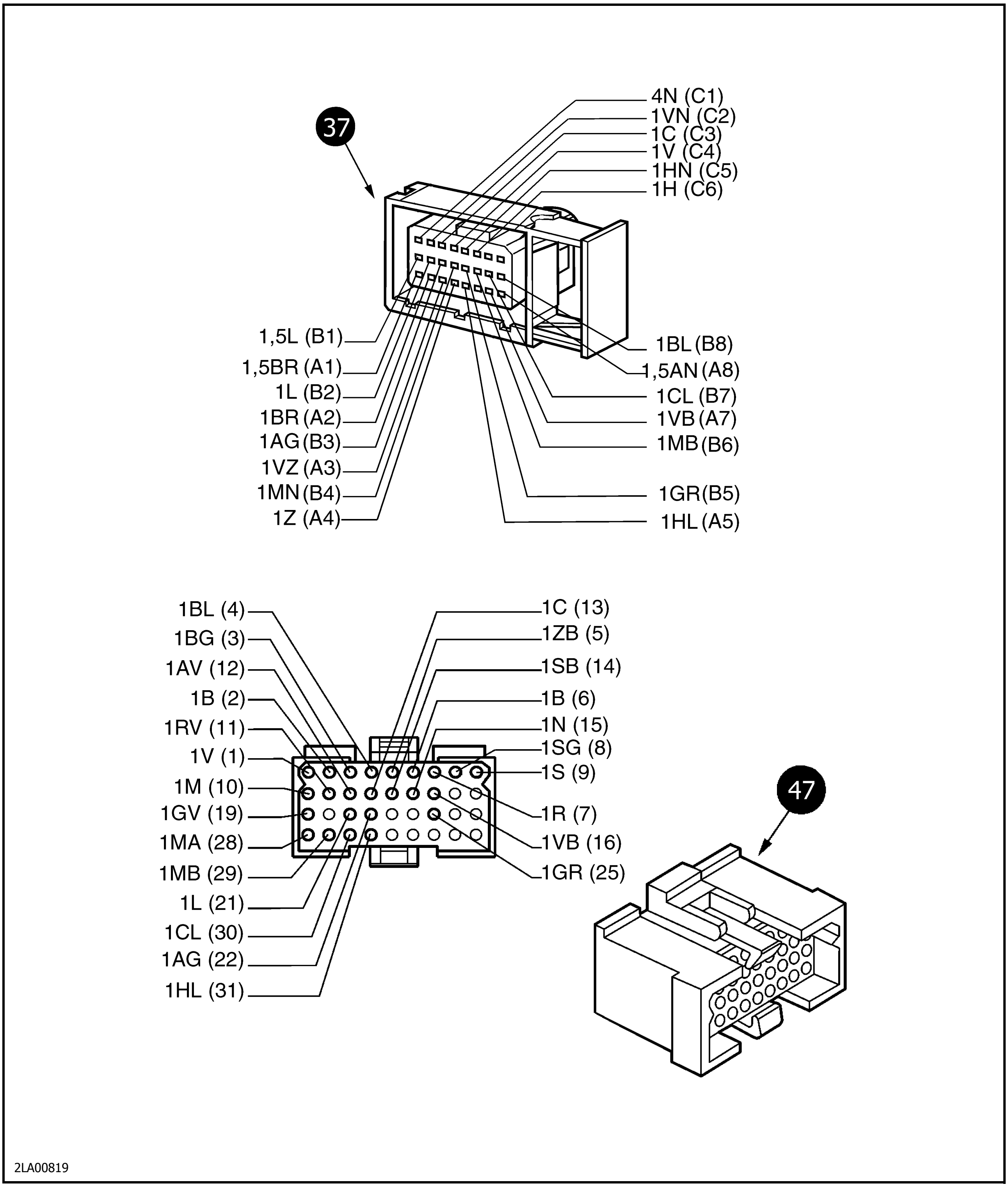

2
1 H
1 V
1 B
3
1HN
1VN
1B
12
1N
1V
1V
1B
18
1G
1B
1M
1R
20
1B
1B
1M
1M
2LA00817

16

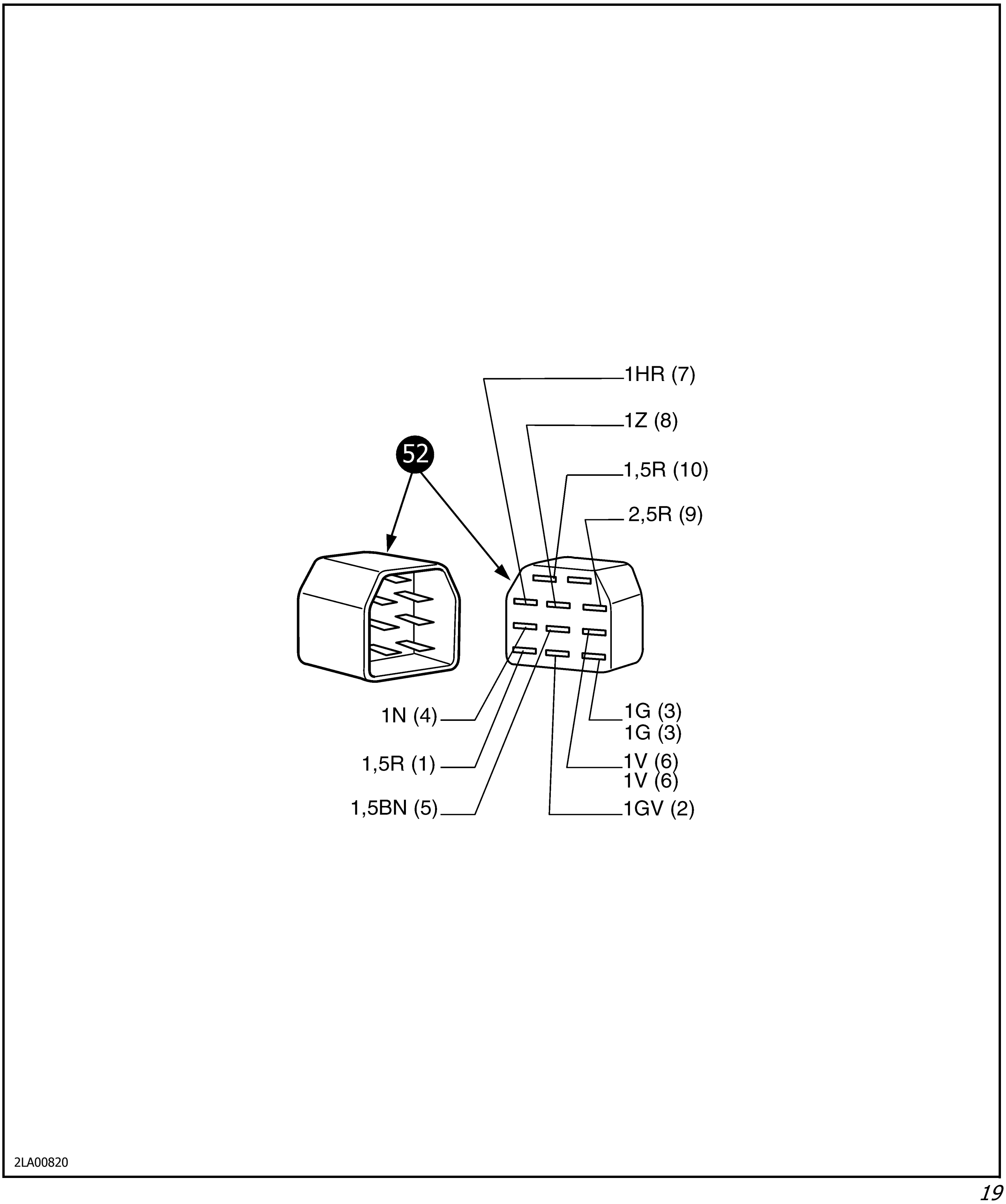


23
1V
1B
1N
1R
26
1M
1G
1B
33
1ZL (C2)
1VZ (C3)
1SB (C4)
1AV (C5)
1BG (C6)
1ZB (C7)
1RV (C8)
1M (B8)
1L (A8)
1LN (B7)
1AG (A7)
1R (B6)
1SG (A6)
1G (B5)
1S (A5)
2,5R (A1)
1V (B2)
1HR (A2)
1N (B3)
1BL (A3)
1M (B4)
1SV (A4)
34
1R (5)
1G (4)
1V (3)
1M (2)
1N (1)
1B (7)
1AG (8)
2,5R (9)
2,5B (10)
2LA00818

17


37
4N (C1)
1VN (C2)
1C (C3)
1V (C4)
1HN (C5)
1H (C6)
1,5L (B1)
1,5BR (A1)
1L (B2)
1BR (A2)
1AG (B3)
1VZ (A3)
1MN (B4)
1Z (A4)
1BL (B8)
1,5AN (A8)
1CL (B7)
1VB (A7)
1MB (B6)
1GR (B5)
1HL (A5)
1BL (4)
1BG (3)
1AV (12)
1B (2)
1RV (11)
1V (1)
1M (10)
1GV (19)
1MA (28)
1MB (29)
1L (21)
1CL (30)
1AG (22)
1HL (31)
1C (13)
1ZB (5)
1SB (14)
1B (6)
1N (15)
1SG (8)
1S (9)
1R (7)
1VB (16)
1GR (25)
47
2LA00819

18


1HR (7)
1Z (8)
52
1,5R (10)
2,5R (9)
1N (4)
1,5R (1)
1,5BN (5)
1G (3)
1G (3)
1V (6)
1V (6)
1GV (2)
2LA00820

19

DIAGRAM OF HAZARD LIGHTS AND TURN INDICATOR BLINKERS – HORN (Diagram D)

6 Horn

12 Rh turn indicator and side light

13 Fuse box

- F9 Courtesy lights
- F10 Key-operated power supplies, hazard light switch
- F11 Hazard light and turn indicator blinker
- F12 NAO circuit
- F13 Power supply to hazard light switch

18 Rh rear light

23 Lh rear light

26 Lh turn indicator and side light

33 Rear wiring connection (24 PIN)

37 Engine wiring connection (24 PIN)

40 60 A maxi fuse for general power supply

46 Hazard light and turn indicator blinker

47 Measuring instrument

- 9 Turn indicators of 1st trailer
- 10 Turn indicators

48 Hazard light control switch

52 External light switch

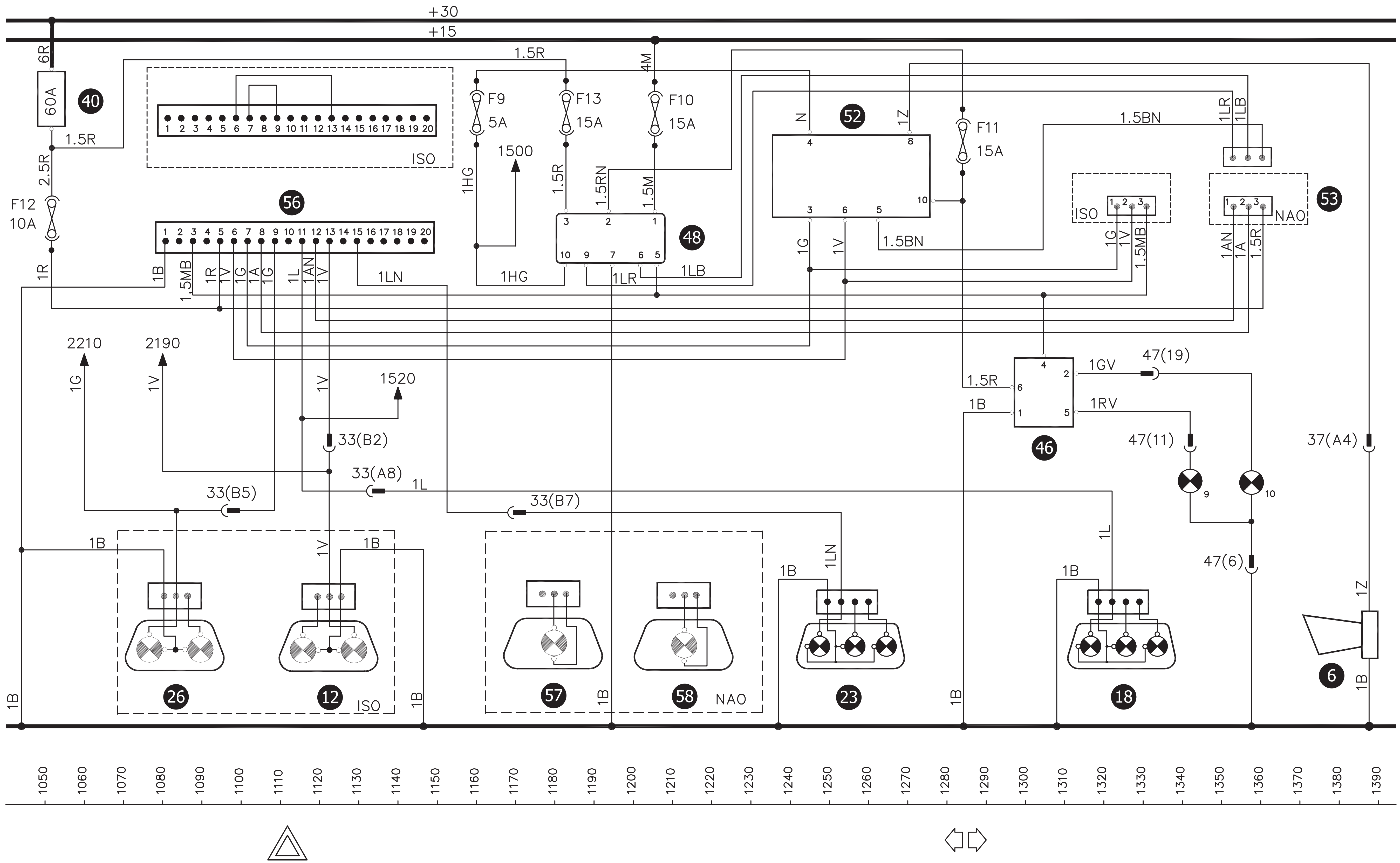
53 Connection for ISO/NAO version (3 PIN)

56 NAO plant

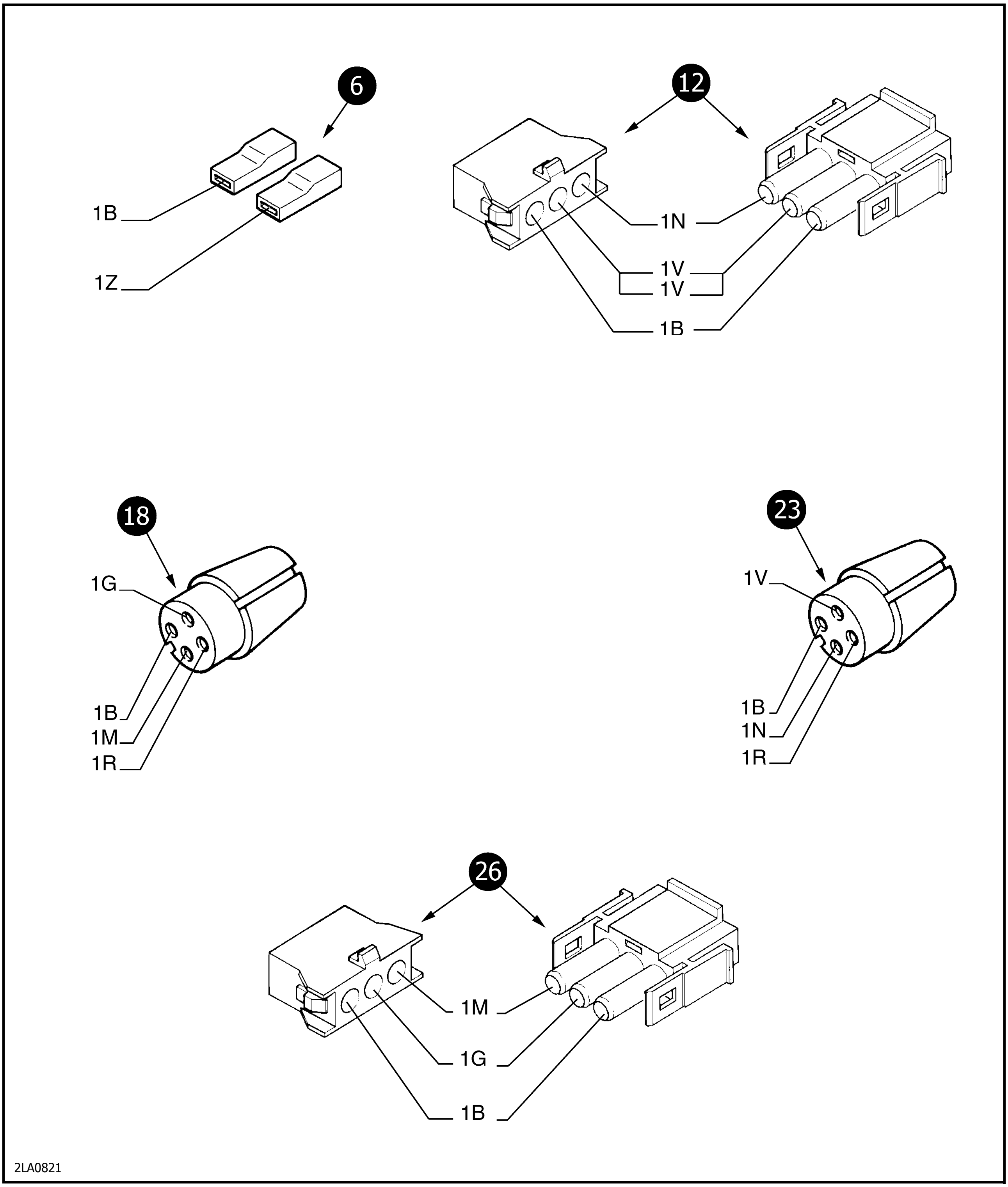
57 Lh front turn indicator light (NAO version only)

58 Rh front turn indicator light (NAO version only)

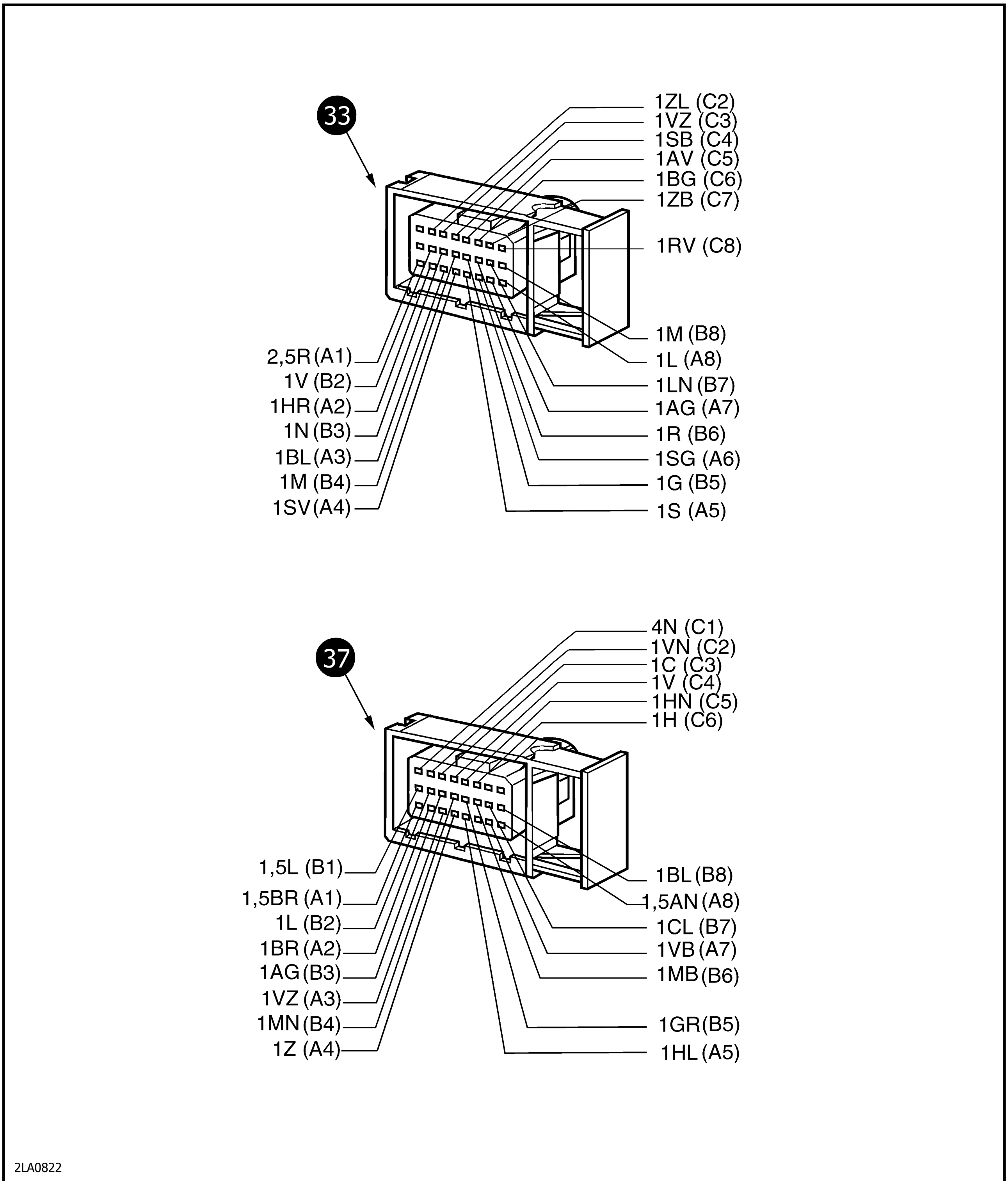
DIAGRAM OF HAZARD LIGHTS AND TURN INDICATOR BLINKERS – HORN - Diagram D



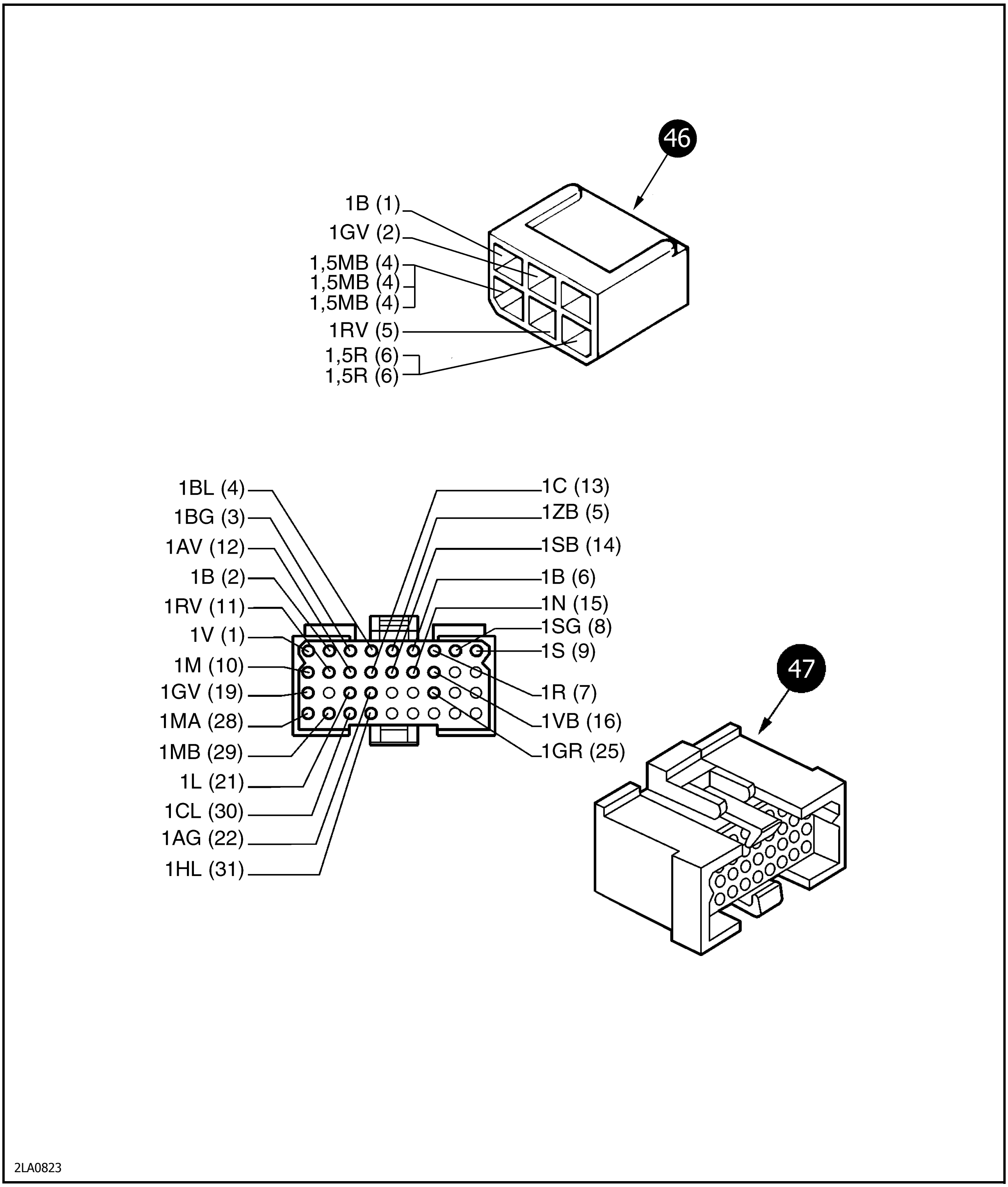
2LA0767


6
1B
1Z
12
1N
1V
1V
1B
18
1G
1B
1M
1R
23
1V
1B
1N
1R
26
1M
1G
1B
2LA0821

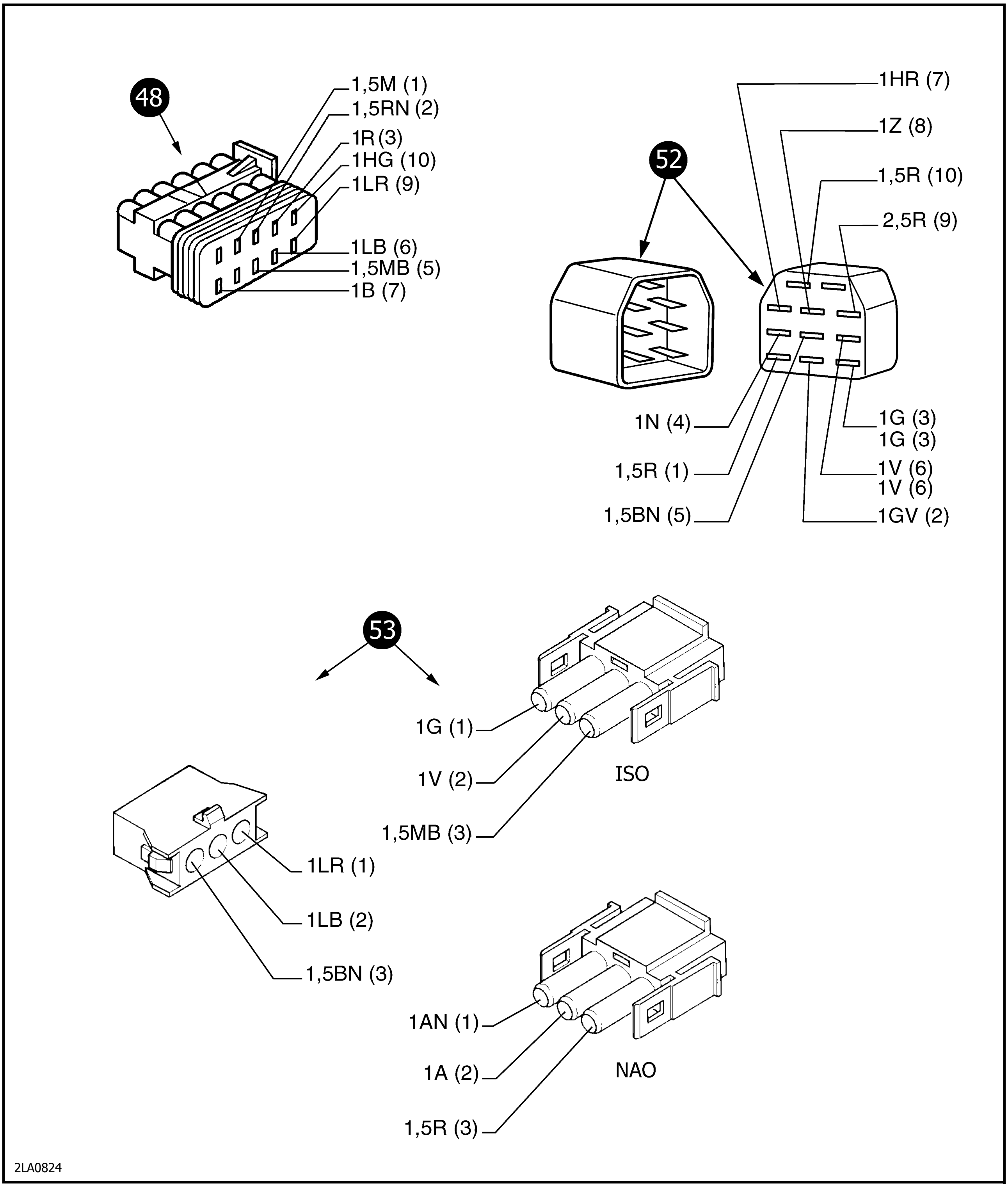
20


33
1ZL (C2)
1VZ (C3)
1SB (C4)
1AV (C5)
1BG (C6)
1ZB (C7)
1RV (C8)
1M (B8)
1L (A8)
1LN (B7)
1AG (A7)
1R (B6)
1SG (A6)
1G (B5)
1S (A5)
2,5R (A1)
1V (B2)
1HR (A2)
1N (B3)
1BL (A3)
1M (B4)
1SV (A4)
37
4N (C1)
1VN (C2)
1C (C3)
1V (C4)
1HN (C5)
1H (C6)
1BL (B8)
1,5AN (A8)
1CL (B7)
1VB (A7)
1MB (B6)
1GR (B5)
1HL (A5)
1,5L (B1)
1,5BR (A1)
1L (B2)
1BR (A2)
1AG (B3)
1VZ (A3)
1MN (B4)
1Z (A4)
2LA0822

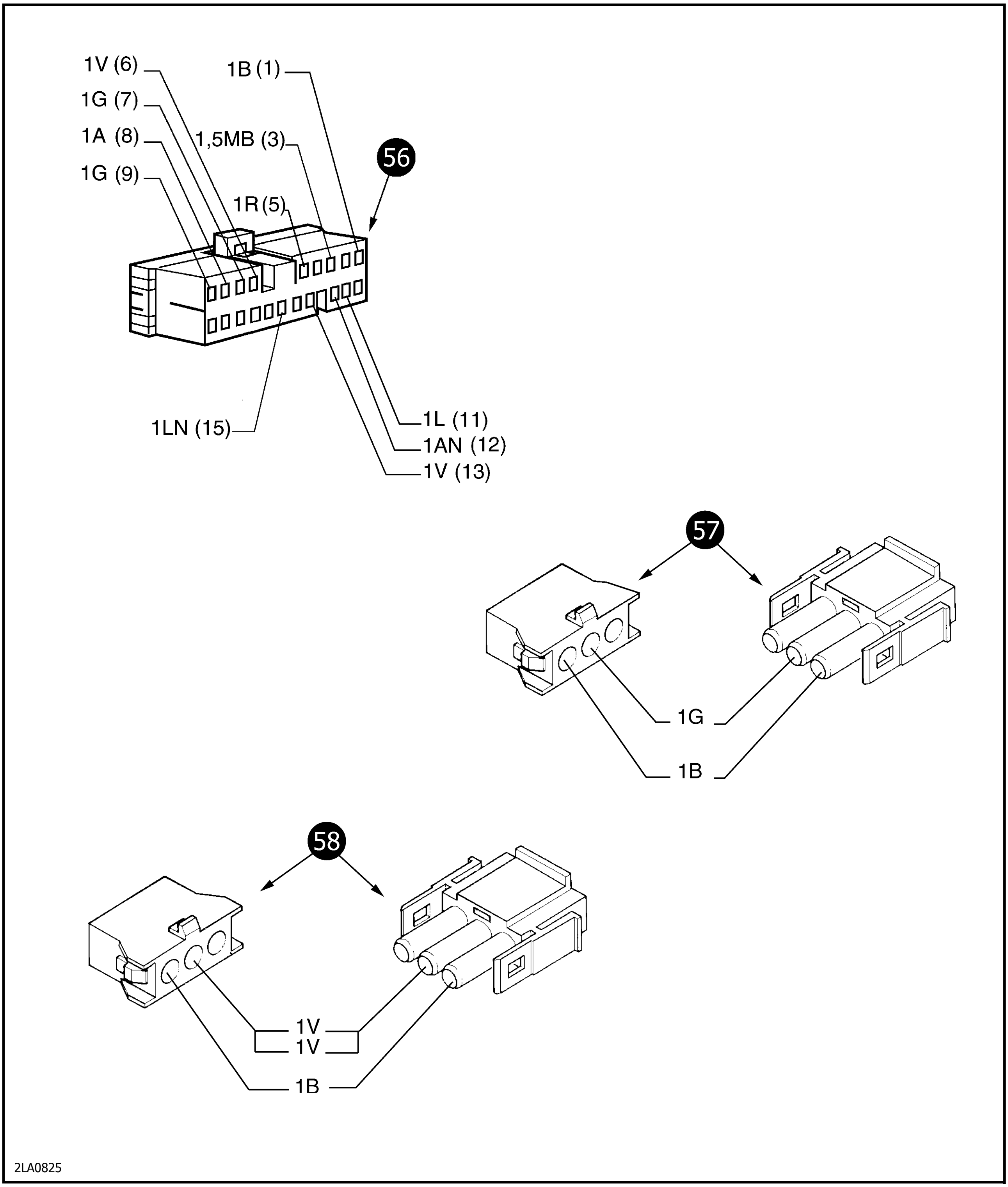
21


46
1B (1)
1GV (2)
1,5MB (4)
1,5MB (4)
1,5MB (4)
1RV (5)
1,5R (6)
1,5R (6)
1BL (4)
1BG (3)
1AV (12)
1B (2)
1RV (11)
1V (1)
1M (10)
1GV (19)
1MA (28)
1MB (29)
1L (21)
1CL (30)
1AG (22)
1HL (31)
1C (13)
1ZB (5)
1SB (14)
1B (6)
1N (15)
1SG (8)
1S (9)
1R (7)
1VB (16)
1GR (25)
47
2LA0823

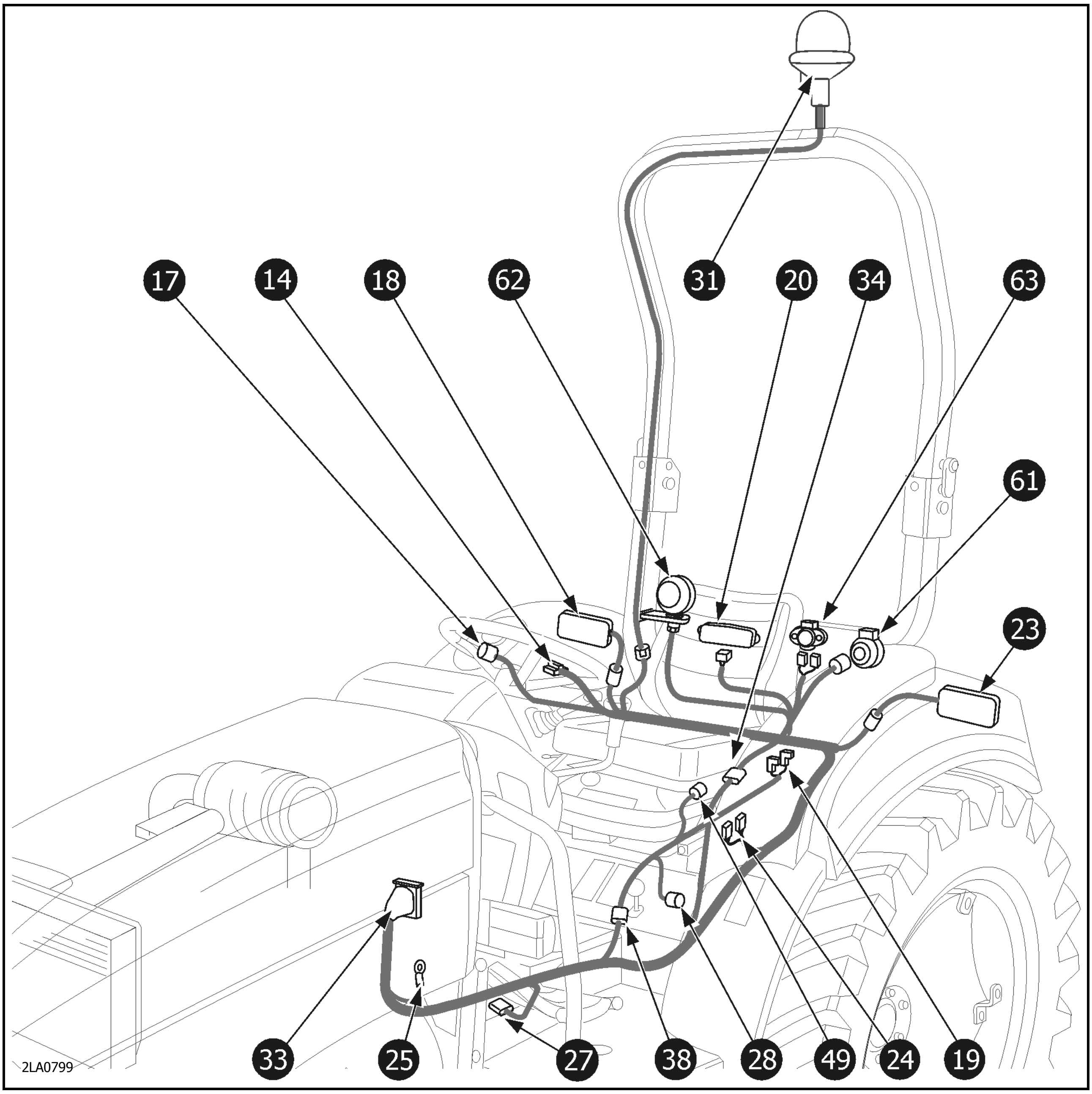
22


48
1,5M (1)
1,5RN (2)
1R (3)
1HG (10)
1LR (9)
1LB (6)
1,5MB (5)
1B (7)
52
1HR (7)
1Z (8)
1,5R (10)
2,5R (9)
1N (4)
1,5R (1)
1,5BN (5)
1G (3)
1G (3)
1V (6)
1V (6)
1GV (2)
53
1G (1)
1V (2)
1,5MB (3)
ISO
1LR (1)
1LB (2)
1,5BN (3)
1AN (1)
1A (2)
1,5R (3)
NAO
2LA0824

23


1V (6)
1B (1)
1G (7)
1A (8)
1,5MB (3)
56
1G (9)
1R (5)
1LN (15)
1L (11)
1AN (12)
1V (13)
57
1G
1B
58
1V
1V
1B
2LA0825

24



25

MAIN REAR WIRING

14 Fuel level transmitter
17 Diff lock control switch
18 Rh rear light
19 Rear PTO speed indicator switch
20 License plate light
23 Lh rear light
24 Parking brake engaged indicator light switch
25 Rear transmission ground
27 4WD indicator light switch
28 Rear PTO safety switch
31 Rotating beacon
33 Rear wiring connection (24 PIN)
34 License plate wiring connection (10 PIN)
38 Operator safety wiring connection (8 PIN)
49 Front PTO safety switch
61 Seven-pin socket
62 Field light
63 25A power socket

DIAGRAM OF BRAKE LIGHTS – FIELD LIGHT – ROTATING BEACON - DIFFERENTIAL LOCK (Diagram E)

9 Diff lock solenoid valve

13 Fuse box

- F1 Diff lock solenoid valve
- F3 Brake lights
- F4 Instrument, alternator diode
- F15 Horn
- F16 Rotating beacon
- F17 Field light

15 Rh brake light switch

16 Lh brake light switch

17 Diff lock control switch

18 Rh rear light

23 Lh rear light

31 Rotating beacon

33 Rear wiring connection (24 PIN)

34 License plate wiring connection (10 PIN)

37 Engine wiring connection (24 PIN)

43 Diff lock circuit relay

47 Measuring instrument

- 14 Differential lock engaged

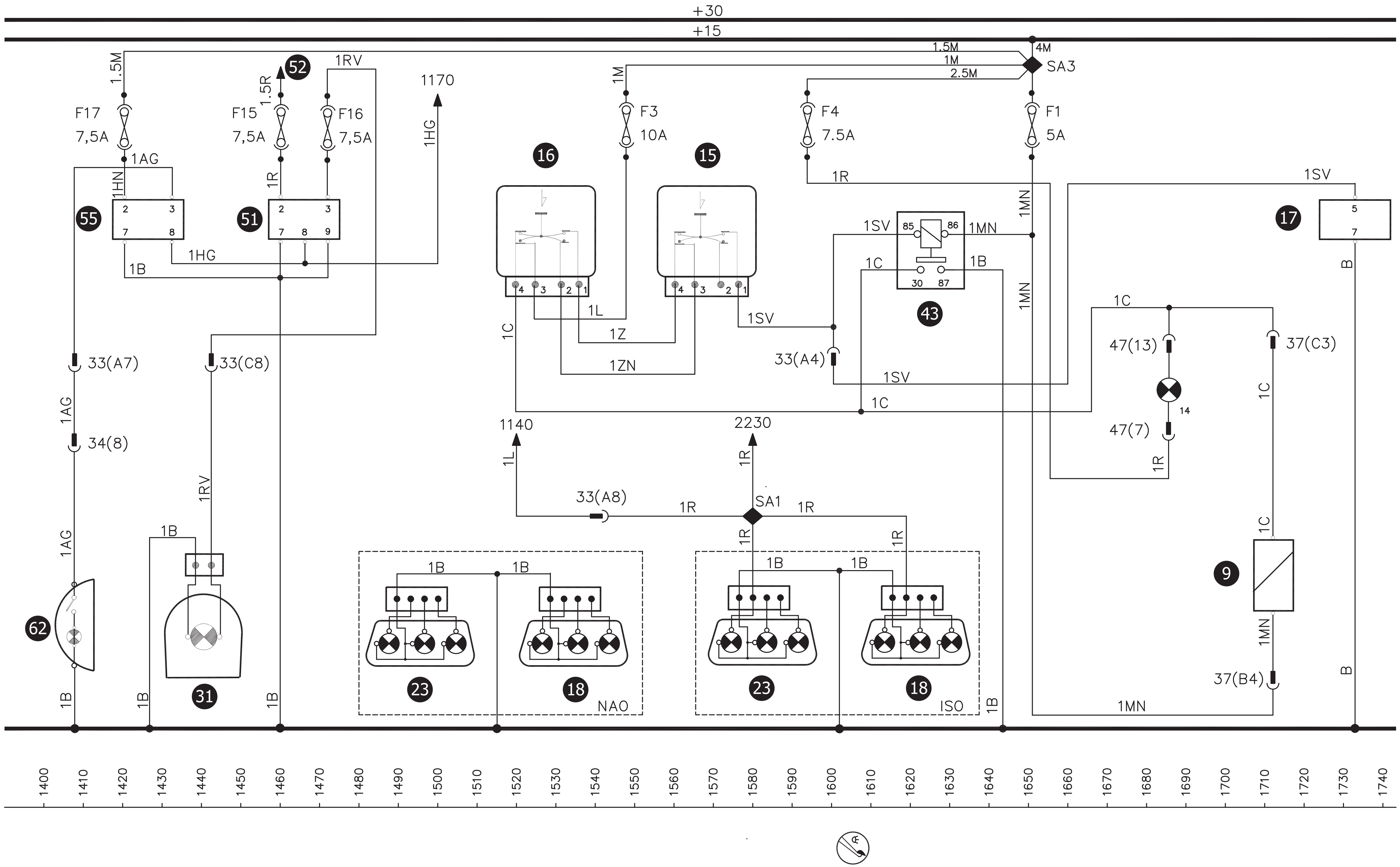
51 Rotating beam control switch

52 External light switch

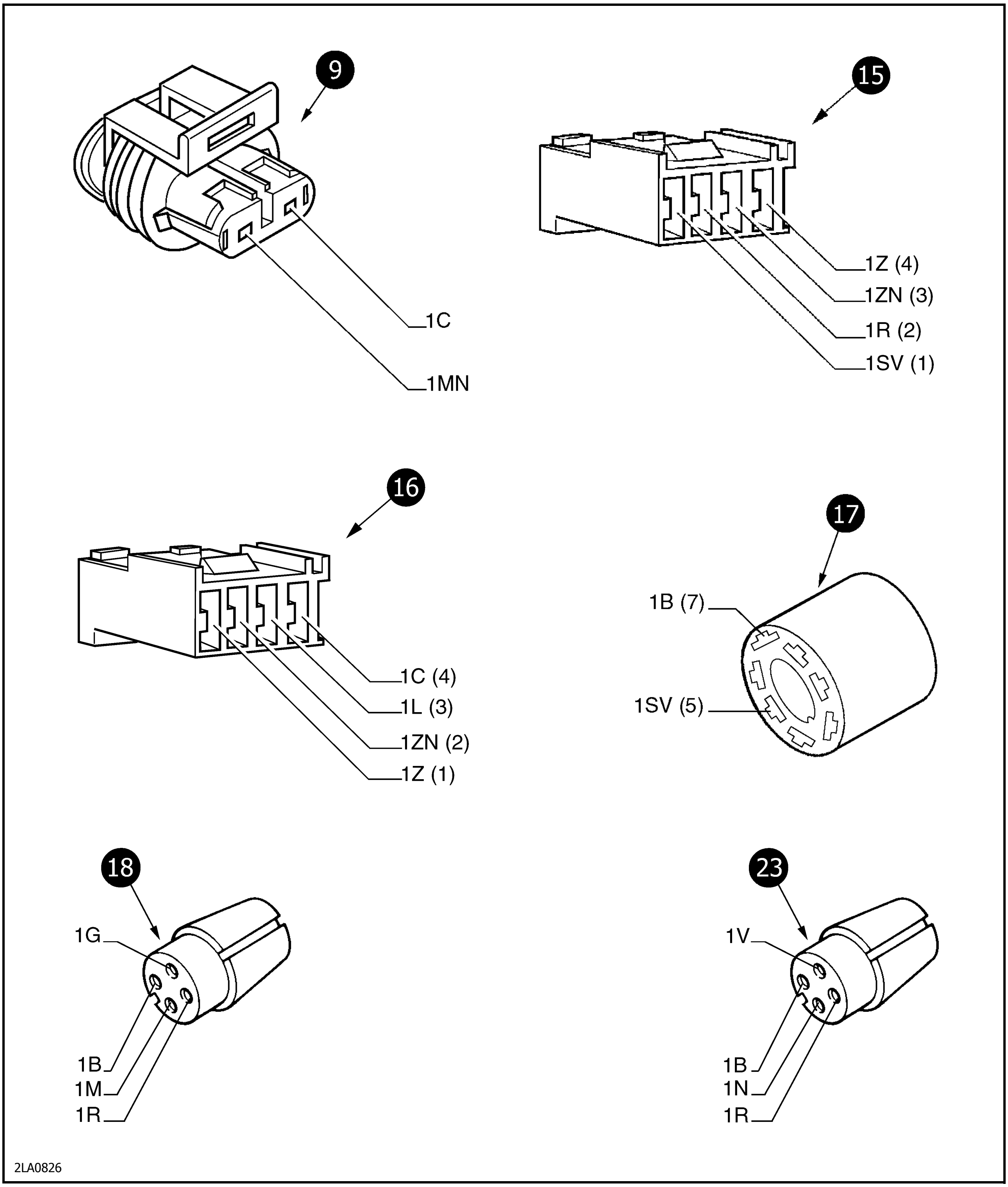
55 Field light control switch

62 Field light

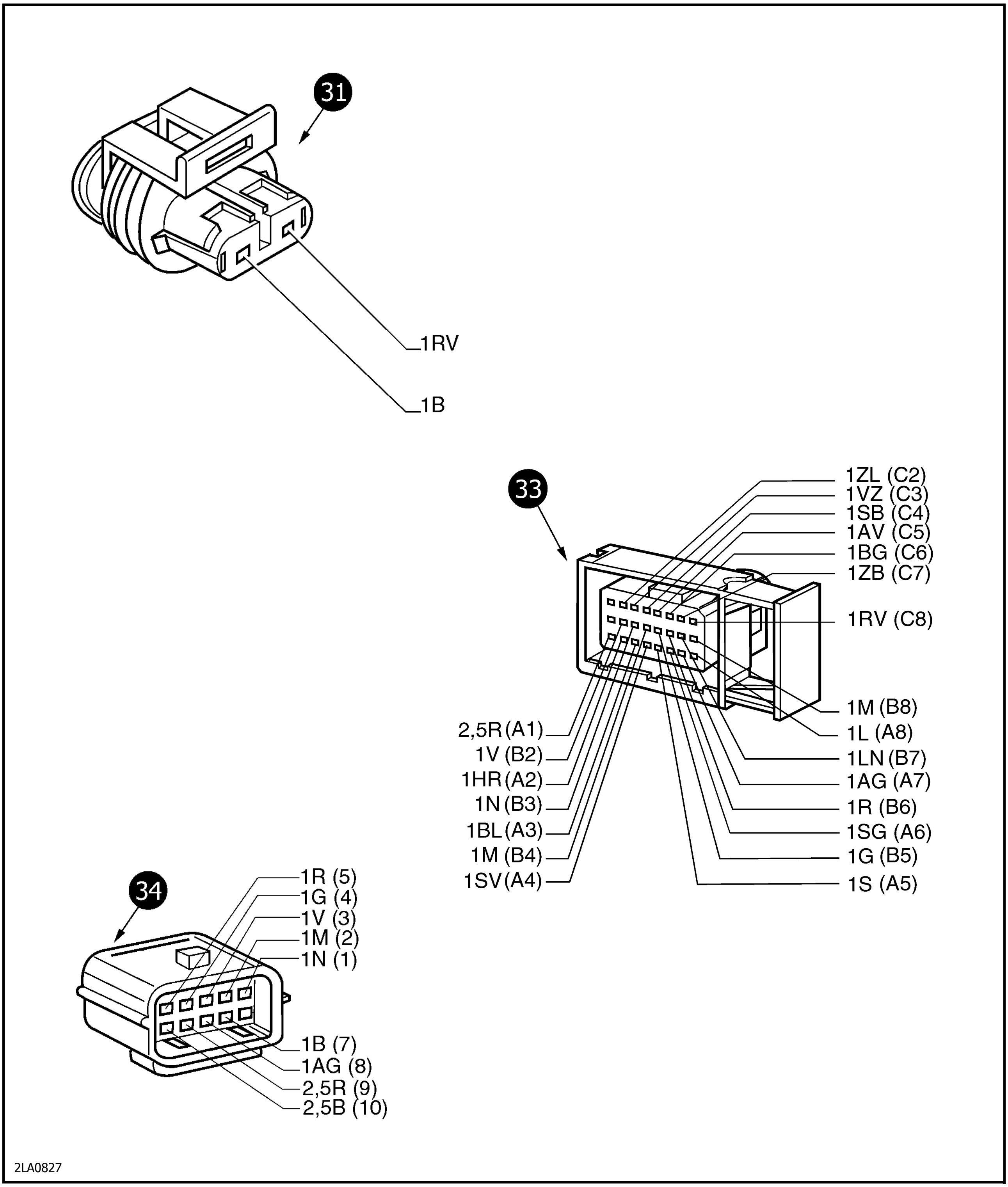
DIAGRAM OF BRAKE LIGHTS – FIELD LIGHT – ROTATING BEACON – DIFFERENTIAL LOCK - Diagram E



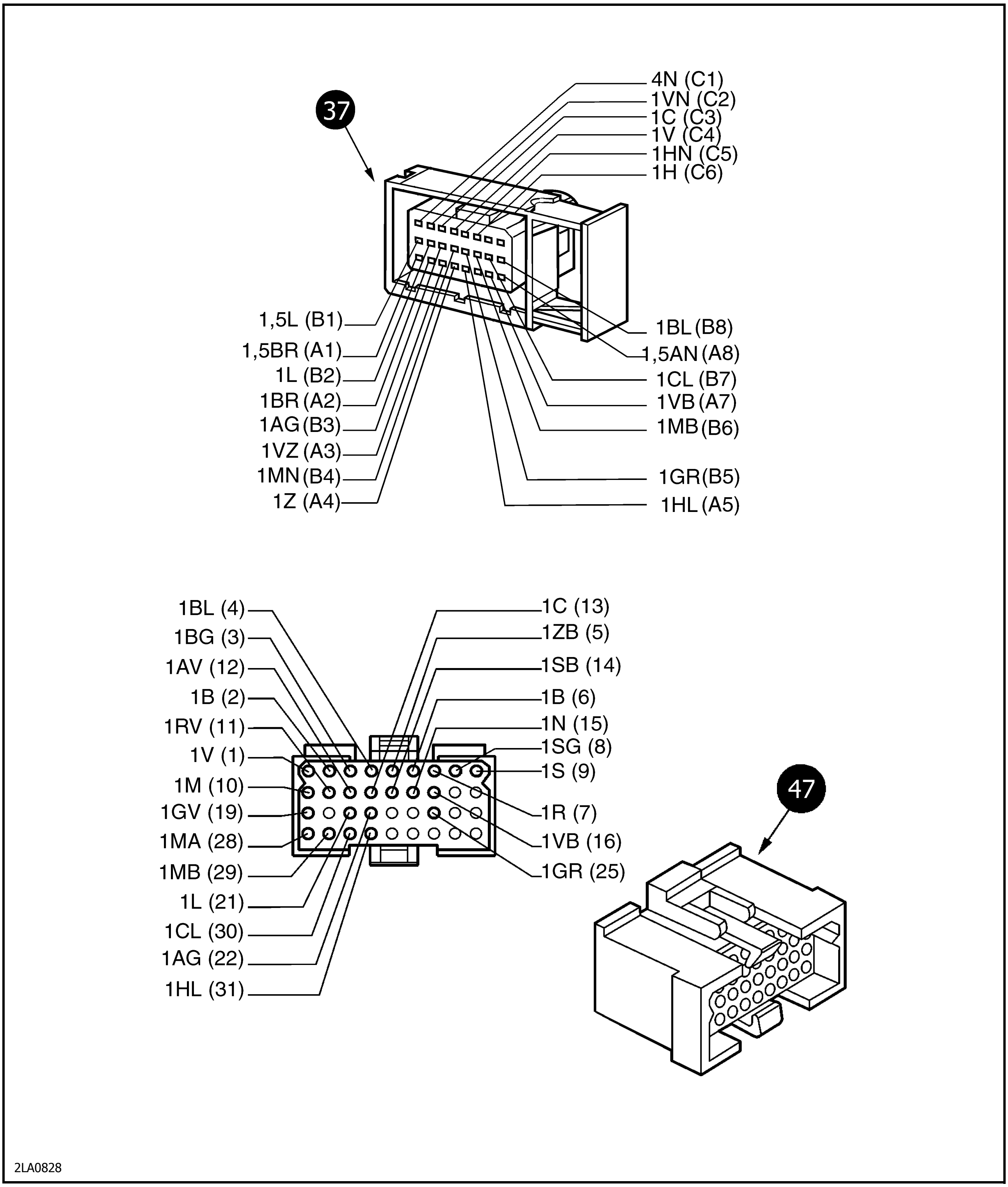
2LA0768


9
1C
1MN
15
1Z (4)
1ZN (3)
1R (2)
1SV (1)
16
1C (4)
1L (3)
1ZN (2)
1Z (1)
17
1B (7)
1SV (5)
18
1G
1B
1M
1R
23
1V
1B
1N
1R
2LA0826

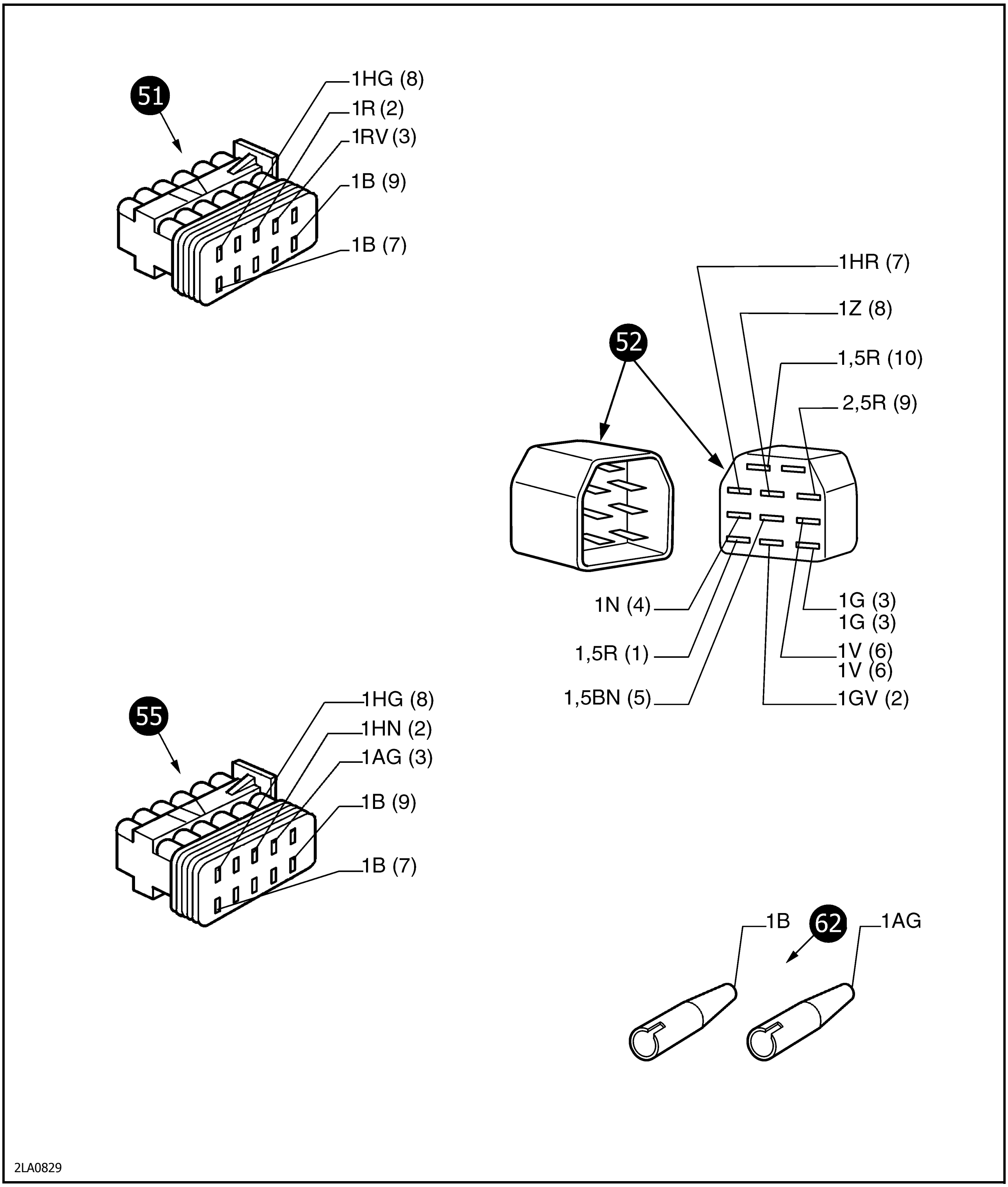
26


31
1RV
1B
33
1ZL (C2)
1VZ (C3)
1SB (C4)
1AV (C5)
1BG (C6)
1ZB (C7)
1RV (C8)
1M (B8)
1L (A8)
1LN (B7)
1AG (A7)
1R (B6)
1SG (A6)
1G (B5)
1S (A5)
2,5R (A1)
1V (B2)
1HR (A2)
1N (B3)
1BL (A3)
1M (B4)
1SV (A4)
34
1R (5)
1G (4)
1V (3)
1M (2)
1N (1)
1B (7)
1AG (8)
2,5R (9)
2,5B (10)
2LA0827

27


37
4N (C1)
1VN (C2)
1C (C3)
1V (C4)
1HN (C5)
1H (C6)
1,5L (B1)
1,5BR (A1)
1L (B2)
1BR (A2)
1AG (B3)
1VZ (A3)
1MN (B4)
1Z (A4)
1BL (B8)
1,5AN (A8)
1CL (B7)
1VB (A7)
1MB (B6)
1GR (B5)
1HL (A5)
1BL (4)
1BG (3)
1AV (12)
1B (2)
1RV (11)
1V (1)
1M (10)
1GV (19)
1MA (28)
1MB (29)
1L (21)
1CL (30)
1AG (22)
1HL (31)
1C (13)
1ZB (5)
1SB (14)
1B (6)
1N (15)
1SG (8)
1S (9)
1R (7)
1VB (16)
1GR (25)
47
2LA0828

28

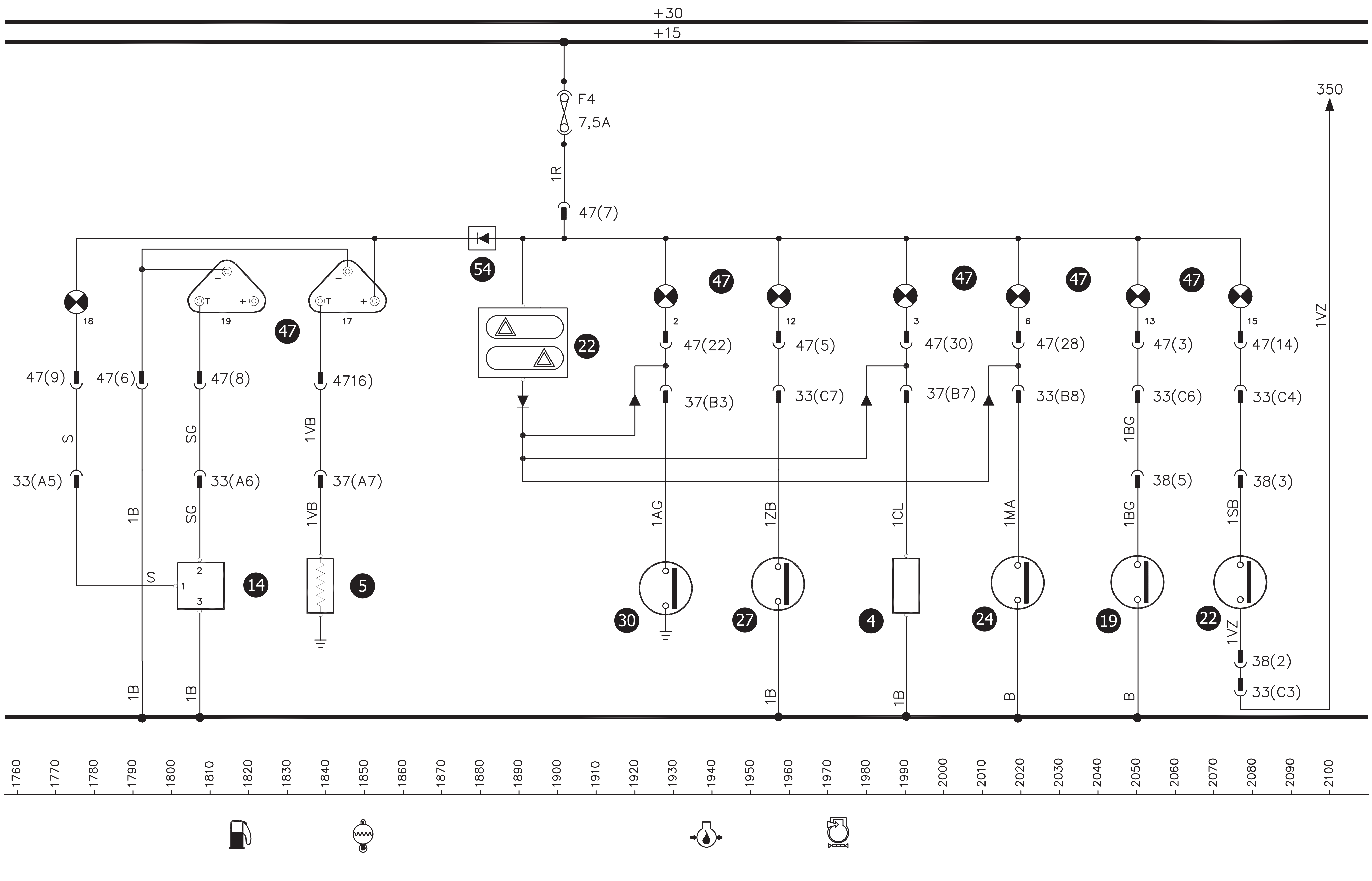

51
1HG (8)
1R (2)
1RV (3)
1B (9)
1B (7)
52
1HR (7)
1Z (8)
1,5R (10)
2,5R (9)
1N (4)
1,5R (1)
1,5BN (5)
1G (3)
1G (3)
1V (6)
1V (6)
1GV (2)
55
1HG (8)
1HN (2)
1AG (3)
1B (9)
1B (7)
1B
62
1AG
2LA0829

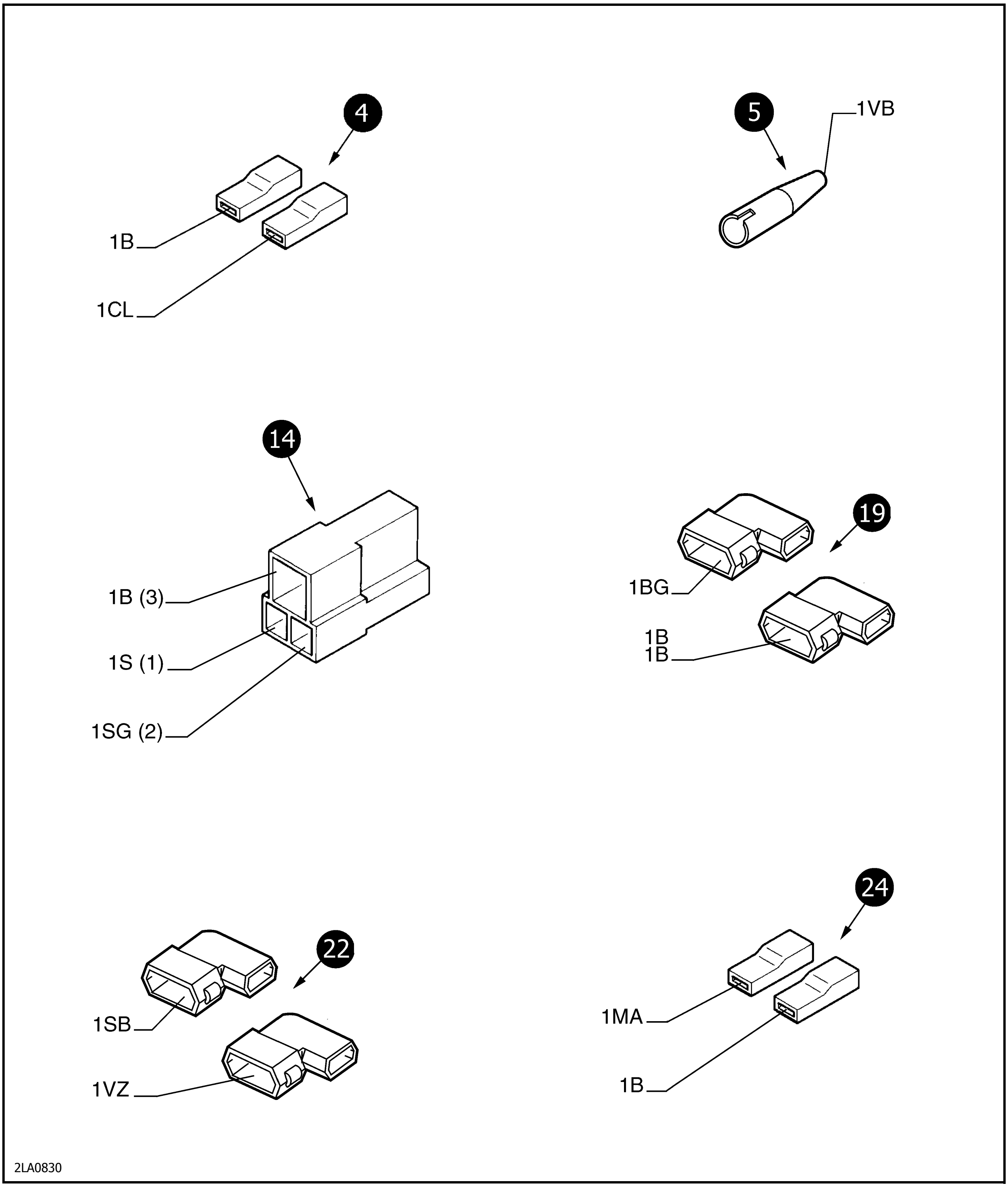
29

DIAGRAM OF SENSORS AND TRANSMITTERS
(Diagram F)

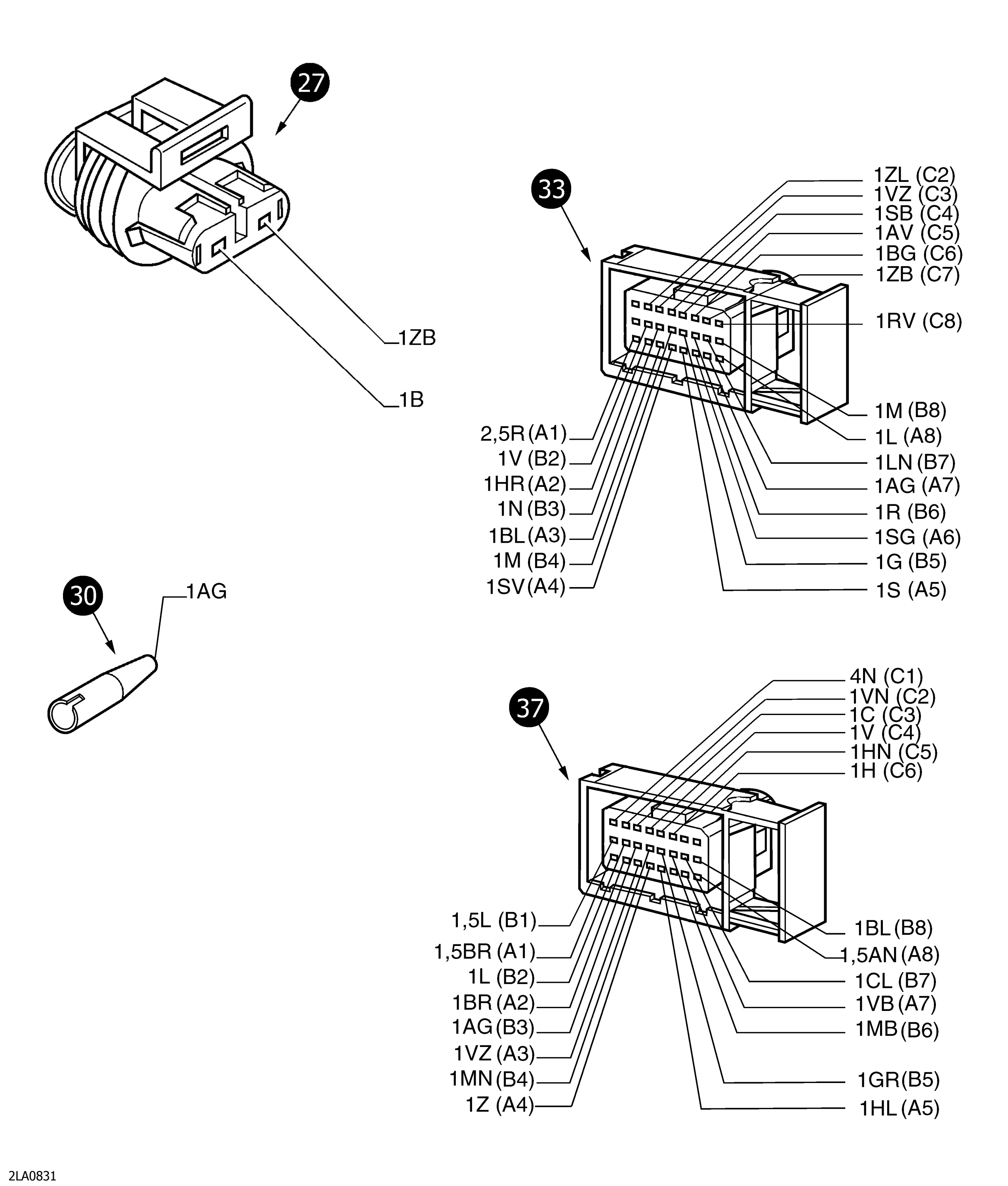
4 Clogged air filter sensor
5 Engine coolant temperature sensor
13 Fuse box
 F4 Instrument, alternator diode
14 Fuel level transmitter
19 Rear PTO speed indicator switch
22 Underbelly PTO engaged indicator light switch
24 Parking brake engaged indicator light switch
27 4WD indicator light switch
30 Engine oil pressure sensor
33 Rear wiring connection (24 PIN)
37 Engine wiring connection (24 PIN)
38 Operator safety wiring connection (8 PIN)
47 Measuring instrument
 2 Insufficient engine oil pressure
 3 Air filter clogged
 6 Hand brake engaged
 12 4WD engaged
 13 Rear PTO speed
 15 Underbelly PTO engaged
 17 Engine coolant temperature indicator instrument
 18 Fuel reserve
 19 Fuel level gauge instrument
 22 General warning light
54 Diode for measuring instrument

DIAGRAM OF SENSORS AND TRANSMITTERS- Diagram F

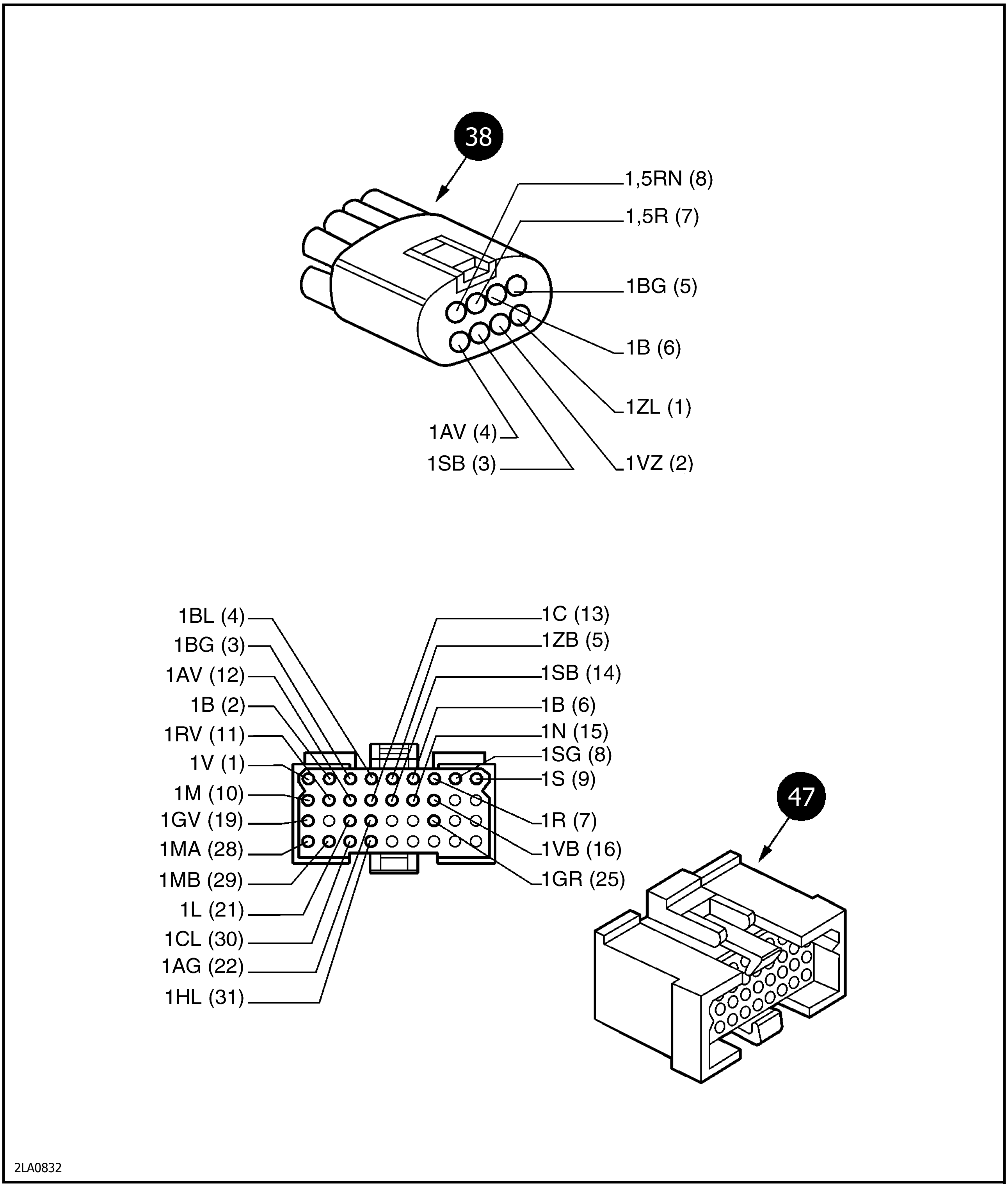



4
1B
1CL
5
1VB
14
1B (3)
1S (1)
1SG (2)
19
1BG
1B
1B
22
1SB
1VZ
24
1MA
1B
2LA0830

30


27
1ZB
1B
33
1ZL (C2)
1VZ (C3)
1SB (C4)
1AV (C5)
1BG (C6)
1ZB (C7)
1RV (C8)
1M (B8)
1L (A8)
1LN (B7)
1AG (A7)
1R (B6)
1SG (A6)
1G (B5)
1S (A5)
2,5R (A1)
1V (B2)
1HR (A2)
1N (B3)
1BL (A3)
1M (B4)
1SV (A4)
30
1AG
37
4N (C1)
1VN (C2)
1C (C3)
1V (C4)
1HN (C5)
1H (C6)
1,5L (B1)
1,5BR (A1)
1L (B2)
1BR (A2)
1AG (B3)
1VZ (A3)
1MN (B4)
1Z (A4)
1BL (B8)
1,5AN (A8)
1CL (B7)
1VB (A7)
1MB (B6)
1GR (B5)
1HL (A5)
2LA0831

31


38
1,5RN (8)
1,5R (7)
1BG (5)
1B (6)
1ZL (1)
1AV (4)
1SB (3)
1VZ (2)
1BL (4)
1BG (3)
1AV (12)
1B (2)
1RV (11)
1V (1)
1M (10)
1GV (19)
1MA (28)
1MB (29)
1L (21)
1CL (30)
1AG (22)
1HL (31)
1C (13)
1ZB (5)
1SB (14)
1B (6)
1N (15)
1SG (8)
1S (9)
1R (7)
1VB (16)
1GR (25)
47
2LA0832

32

DIAGRAM OF 7-PIN SOCKET, POWER SOCKET
(Diagram G)

13 Fuse box

F19 25A power socket

33 Rear wiring connection (24 PIN)

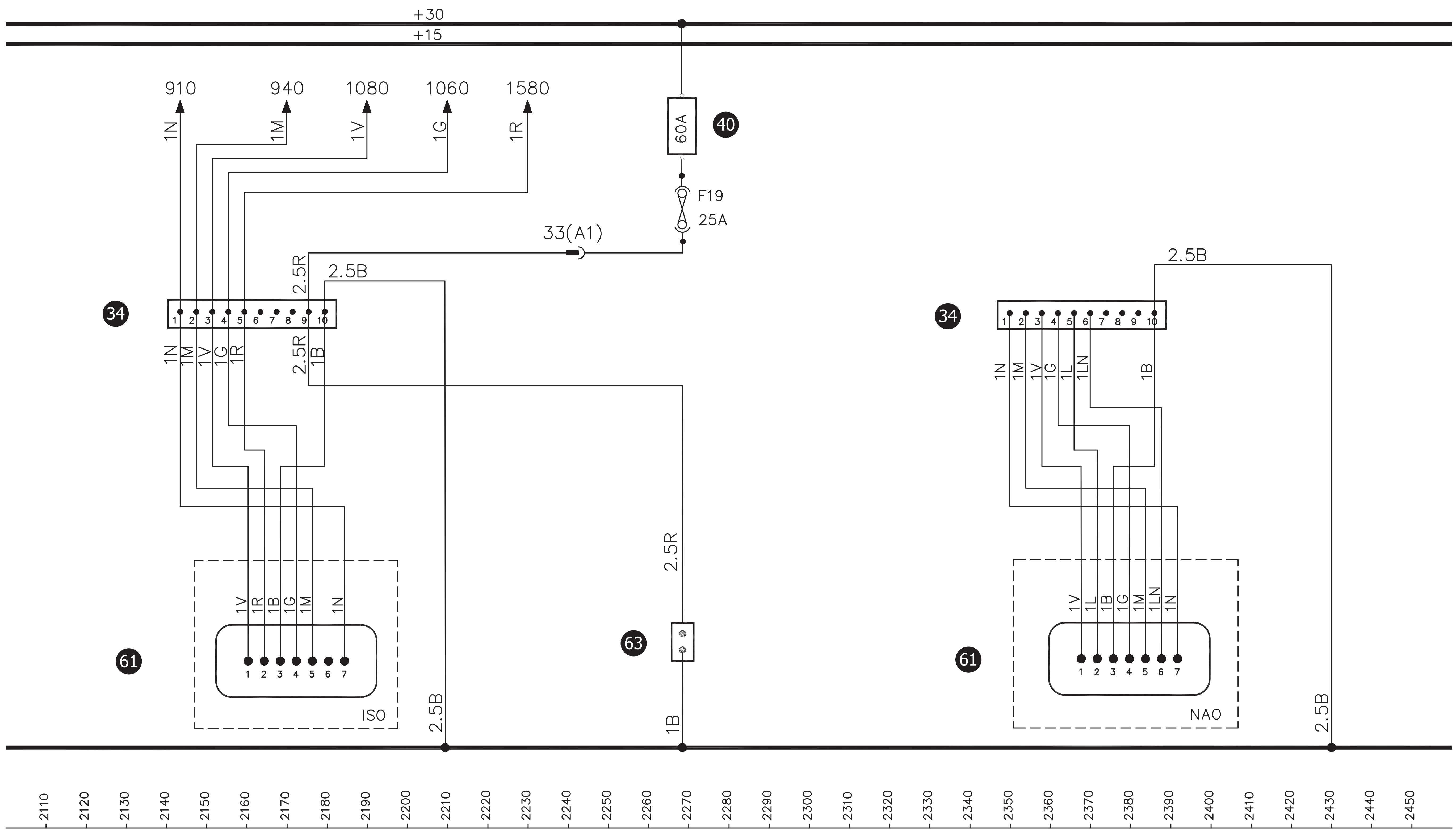
34 License plate wiring connection (10 PIN)

40 60 A maxi fuse for general power supply

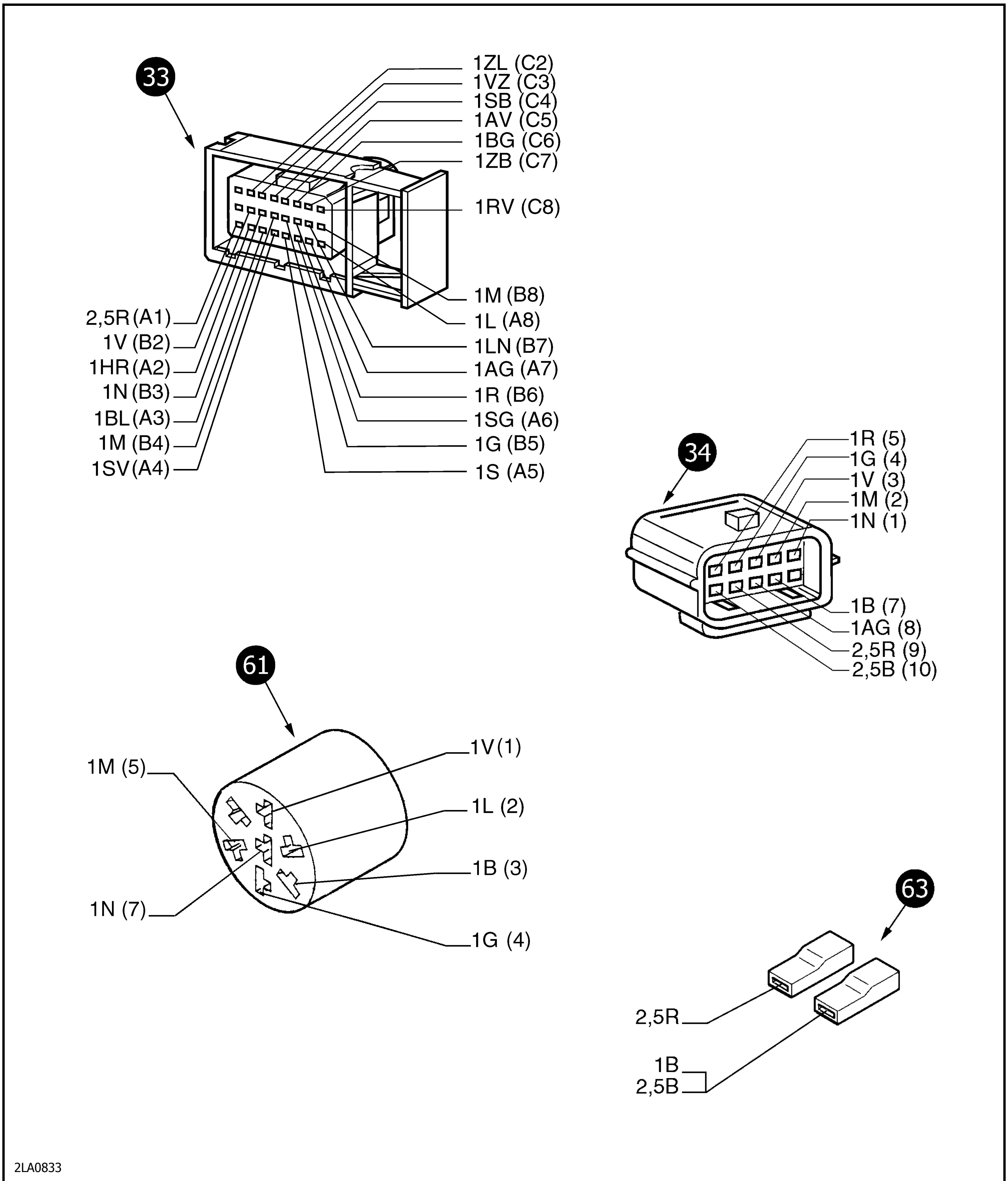
61 Seven-pin socket

63 25A power socket

DIAGRAM OF 7-PIN SOCKET, POWER SOCKET - Diagram G



2LA0770



33
1ZL (C2)
1VZ (C3)
1SB (C4)
1AV (C5)
1BG (C6)
1ZB (C7)
1RV (C8)
1M (B8)
1L (A8)
1LN (B7)
1AG (A7)
1R (B6)
1SG (A6)
1G (B5)
1S (A5)
2,5R (A1)
1V (B2)
1HR (A2)
1N (B3)
1BL (A3)
1M (B4)
1SV (A4)
34
1R (5)
1G (4)
1V (3)
1M (2)
1N (1)
1B (7)
1AG (8)
2,5R (9)
2,5B (10)
61
1M (5)
1N (7)
1V (1)
1L (2)
1B (3)
1G (4)
63
2,5R
1B
2,5B
2LA0833

33